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GLOBAL SERVICE LEARNING

TECHNICAL PRESENTATION

"B" SERIES SKID STEER LOADERS AND MULTI-TERRAIN LOADERS

MACHINE SYSTEMS OPERATION

Service Training Meeting Guide
(STMG)

"B" SERIES SKID STEER LOADERS AND MULTI-TERRAIN LOADERS

MACHINE SYSTEMS OPERATION

AUDIENCE

Level II - Service personnel who understand the principles of machine systems operation, diagnostic equipment, and procedures for testing and adjusting.

CONTENT

This presentation identifies the components and describes the operation of the electronically controlled pilot system, power train hydraulic system, and the work tool hydraulic system on the "B" Series Skid Steer Loaders and Multi-Terrain Loaders.

OBJECTIVES

After learning the information in this presentation, the technician will be able to:

1. locate and identify the major components in the operator's station, rear compartment, pilot system, power train, and work tool hydraulic system;
2. explain the function of the major components in the operator's station;
3. explain the function of the major components in the rear compartment, pilot system, power train, and work tool hydraulic system;
4. locate and identify the maintenance locations and test points;
5. trace oil flow through the hydrostatic drive and work tool hydraulic systems; and
6. explain the operation of the hydrostatic drive and work tool hydraulic systems.

REFERENCES

STMG777 "Distributor-Type Mechanical Fuel Pump, 3044C and 3046 Tier II Engines"	SERV1777
3024C Engine For Caterpillar Built Machines Systems Operation/Testing and Adjusting	SENR5005
3044, 3044C and 3046 Engines For Caterpillar Built Machines Systems Operation/Testing and Adjusting	SENR6457
NPI "B" Series Skid Steer Loader and Multi-Terrain Loader	SERV7104

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1

INTRODUCTION

The "B" Series Skid Steer Loaders and Multi-Terrain Loaders are a direct replacement for all previous Skid Steer (SSL) and Multi-Terrain Loaders (MTL) with the exception of the 228, which has been discontinued. The 268B will join the product line, which keeps Caterpillar's SSL and MTL product line at 15 models.

The key design changes consist of Tier II compliant engines with more performance and horsepower, improved operator environment, more high flow options, and improved serviceability and reliability.

> ***NOTE:*** *The HYDRAULIC SCHEMATIC COLOR CODE is located after the CONCLUSION of this presentation.*

Refer to the "Skid Steer Loader and Multi-Terrain Loader Abbreviation and Acronym Glossary" at the end of the presentation for a complete listing of acronyms and abbreviations used during the presentation.

"B" SERIES SSL / MTL FAMILIES
FOUR BASE MACHINES

Base Machine	XR	MTL	MTL/ XR	XPS HF	XPS HF/ XR	Engine
216B (RLL)	232B (SCH)					3024C
226B (MJH)	242B (BXM)	247B (MTL)	257B (SLK)			3024CT
236B (HEN)	252B (SCP)	267B (CYC)				3044C DIT
246B (PAT)	262B (PDT)	277B (MDH)	287B (ZSA)	248B (SCL)	268B (LBA)	3044C DIT

XR = Extended Reach
MTL = Multi-Terrain Loader
HF = High Flow
High Flow Optional
Two-speed Optional
XPS HF Optional

2

There are four base machines in the "B" Series Skid Steer Loader product line. The remaining machines in the product line are variations of the four base machines as shown in this illustration.

Machines with model numbers ending with a "6" are the base models. Machines with model numbers ending with a "2" are equipped with Extended Reach (XR) linkage. Machines with model numbers ending with a "7" are multi-terrain loaders. Machines with model numbers ending with an "8" are equipped with the XPS High Flow hydraulics.

NOTE: *The 226B, 242B, and 257B are available with an optional high flow attachment.*

The 236B, 246B, 248B, 252B, 262B, and 268B are available with the optional two-speed feature.

KEY NEW FEATURES

- **Caterpillar Tier II Compliant Engines**
- **Improved Operator Environment**
- **More Hydraulic Options**
- **Improved Electrical System**

3

Key new features for the "B" Series Skid Steer Loaders and Multi-Terrain Loaders include:

Caterpillar Tier II Compliant Engines – All models, with the exception of the 216B and 232B use turbocharged engines. The 226B, 242B, 247B, and 257B use the 2.2-liter 3024CT turbocharged engine. The remaining machines in the product line use the new 3.3-liter 3044 C DIT turbocharged engine. A six-cylinder version of the 3044 C DIT Engine is used in Caterpillar's D3G, D4G, and D5G Series Track-type Tractors.

Improved Operator Environment – New joystick handles with more electrical and hydraulic flow options are used on machines equipped with high flow or proportional auxiliary hydraulics. The continuous flow switch is relocated to the speed and direction lever on the standard and optional joysticks. An auxiliary pressure release switch is now standard equipment.

A new more comfortable armrest is used. The front door has been redesigned on machines equipped with enclosed cabs to provide 25% more glass for better visibility to the work tool. The standard door switch disables lift and tilt functions while the door is open. A rear view mirror is standard.

The fuse panel, 12-Volt power plug, and diagnostic connector are located below the operator's seat. The air filter restriction indicator is now a warning light on the instrument panel.

More Hydraulic Options – High flow auxiliary hydraulics are standard on the 248B and 268B and optional on 226B, 242B, and 257B. The optional high flow system on the 226B, 242B, and 257B uses an additional gear pump to provide additional flow beyond the flow provided by the standard gear pump. The XPS high flow hydraulic system used on the 248B and 268B uses a variable-displacement piston-type pump and a new mono-block control valve. The valves, pumps, and lines on the 248B and 268B have been improved to reduce over 50 hydraulic connections for improved reliability.

The two-speed travel option previously offered only on the 236, 246, 252, and 262 is now also available on the 248B and 268B. The two-speed travel option allows increased productivity in applications where low rimpull and high travel speeds are desired.

Improved Electrical System – The fuse panel has been relocated from behind the operator's seat to a position below the operator's seat. The diagnostic connector is relocated from the engine compartment to near the fuse panel.

The Operator Interlock Electronic Control Module (ECM) and Auxiliary Hydraulic ECM are now mounted to the inside of the frame below the floorplate. The electrical harnesses have been simplified for improved reliability.

SIMILARITIES AND DIFFERENCES

FEATURES	DIFFERENT	SIMILAR	SAME
Machine Appearance		X	
Operator's Station		X	
Engine	X		
Power Train		X	
Hydrostatic Drive System		X	
Work Tool Hydraulic System		X	
High Flow Hydraulic System	X		
Electrical System		X	
Maintenance Items		X	

4

Most of the systems on the "B" Series Skid Steer and Multi-Terrain Loaders are similar to the former models.

The operator's station is similar to former models; however, some changes were made. The fuse panel was relocated from behind the operator's seat to a space below the operator's seat. The diagnostic connector and a 12-Volt power port are located next to the fuse panel. The armrest was redesigned for increased comfort.

The 216B and 232B Skid Steer Loaders continue to use the 3024C Engine. The 226B, 242B, 247B, and 257B use a turbocharged version of the 2.2-liter 3024C Engine. The remaining models use the new 3.3-liter, turbocharged 3044 C DIT Engine.

The power train and hydrostatic drive system are functionally unchanged. Some skid steer models are available with the optional two-speed travel system. All models except the 267B, 277B, and 287B use a mono-block hydrostatic pump.

The work tool hydraulic system on standard flow machines is similar to former machines.

The high flow systems are different. The 248B and 268B use a new closed-center control valve group. The 226B, 242B, and 257B are available with an optional high flow system that provides flow for high flow work tools. The high flow system uses an additional gear pump and control valve to "boost" the flow from the auxiliary circuit in one direction.

The electrical system functions similarly to the former models. The Operator Interlock ECM and the Auxiliary Hydraulic ECM are now mounted to the inside of the lower frame below the floorplate. Harness connections and routing have been simplified for improved reliability.

Similar maintenance procedures are used. Some of the service locations have changed.

5

OPERATOR'S STATION

The Skid Steer Loader cab provides optimal space and visibility. The optional enclosed cab is shown in this illustration.

A Rollover Protective Structure (ROPS) cab is standard. A Falling Object Protective Structure II (FOPS II) cab is available as an option. The FOPS II cab can be used for applications that require protection from large, heavy, falling objects.

A Flying Objects Guard (FOG) option is available as protection against flying objects from some work tools.

6

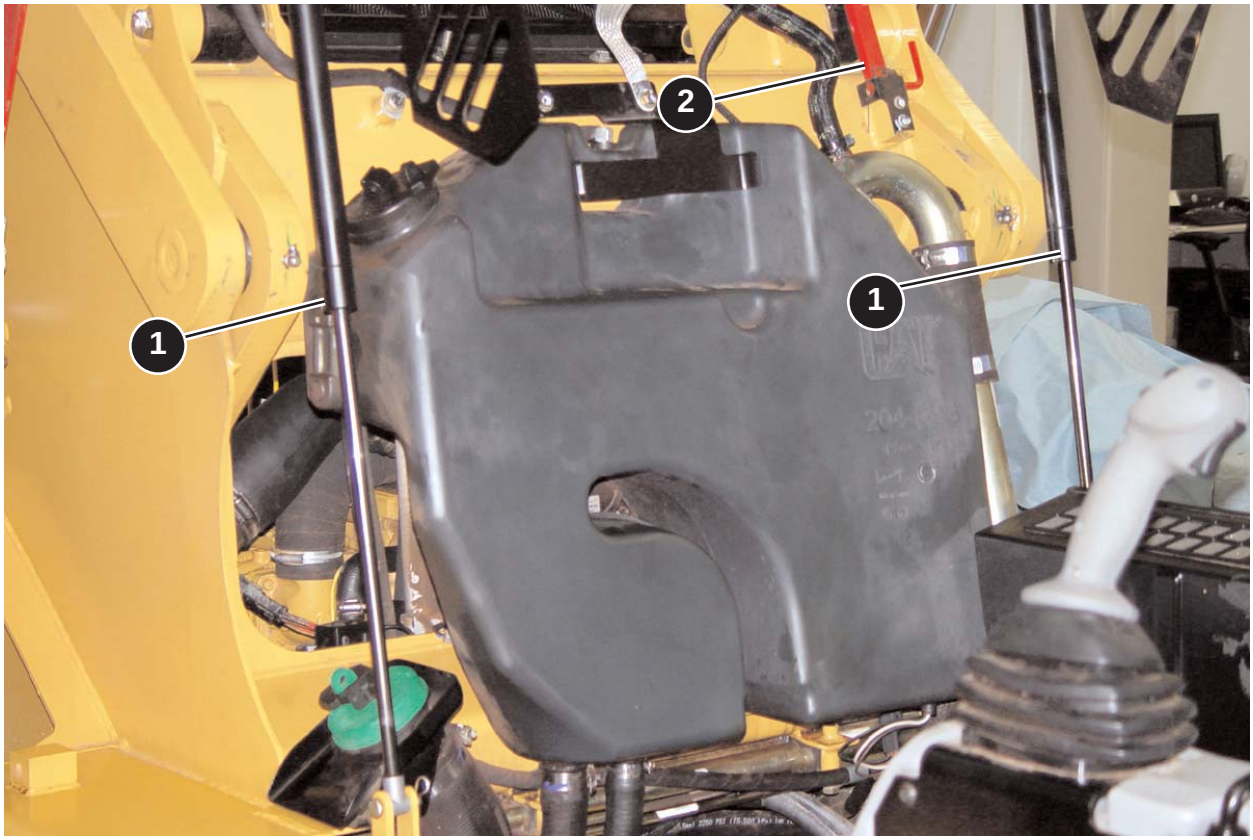
For machines equipped with the optional enclosed operator's compartment, a new door (1) provides the operator with greater visibility to the work tool.

The door switch (2) prevents lift arm movement while the door is open. The door switch prevents door damage due to inadvertent lift arm movement.

A rocker switch (3) in the base of the door activates the window wipers.

The windshield washer reservoir (4) has been relocated from the base of the door to inside the front of the operator's compartment.

***NOTE*:** *A kit will be available for retrofitting the new door to earlier machines.*

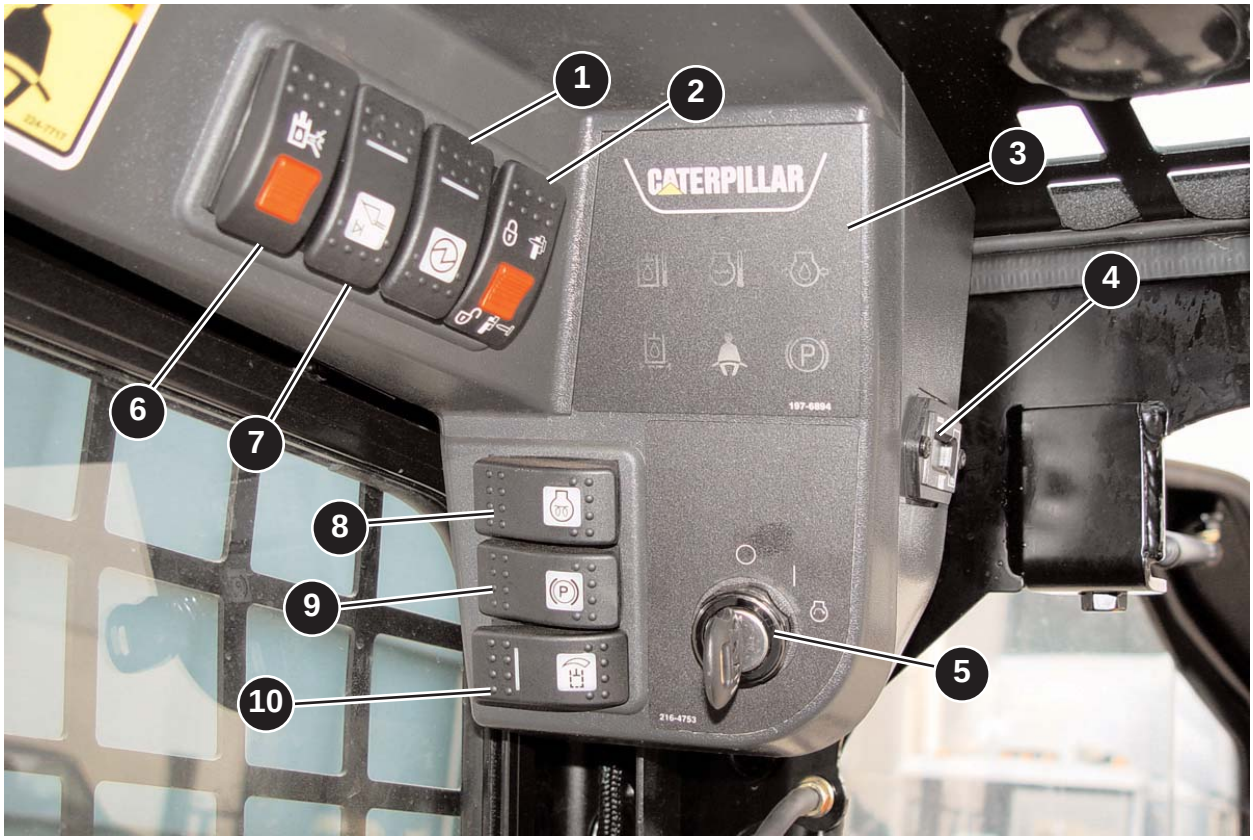


7

The operator's compartment can be raised by removing two bolts at the front of the compartment to allow access to components. In the raised position, the enclosed operator's compartment (shown) is supported by two gas struts (1). The standard operator's compartment is supported by a single gas strut.

A lever (2) located on the left side of the machine keeps the operator's compartment locked in the upright position.

NOTE: *Different gas struts are used for different operator's compartment weights. Which strut is used for a given machine depends on the optional attachments installed in the operator's compartment.*



8

This illustration shows the left console which is located in the upper, left corner of the operator's compartment. The left console contains the following components:

Auxiliary electrical control switch (1) – The rocker switch energizes pin H on the work tool electrical connector on the lift arm. Some work tools utilize pin H to actuate a diverter valve or a water tank.

Work tool coupler control (2) – The rocker switch controls the engagement of the work tool coupler pins. Depress the top of the rocker switch to engage the coupler pins. Slide the red locking tab upward and depress the bottom of the rocker switch to release the pins.

Indicator lamps (3) – The left console contains indicator lamps for high hydraulic oil temperature, high engine coolant temperature, low engine oil pressure, restricted hydraulic oil filter, empty seat and raised armrest, and engaged parking brake.

Service hour meter (4) – The service hour meter is located on the right face of the left console, so that it can be viewed from outside the machine.

Engine key start switch (5) – Turn the engine key start switch to the start position while seated in the operator's seat with the armrest down in order to start the engine.

Auxiliary hydraulic pressure release (6) – Slide the red locking tab upward and depress the bottom of the rocker switch to release hydraulic pressure in the auxiliary hydraulic lines (A1 and A2) to make connecting and disconnecting work tools easier.

Automatic level control (7) – The automatic level control maintains the selected work tool angle as the lift arms are raised. Depress the top of the switch to activate the automatic level control.

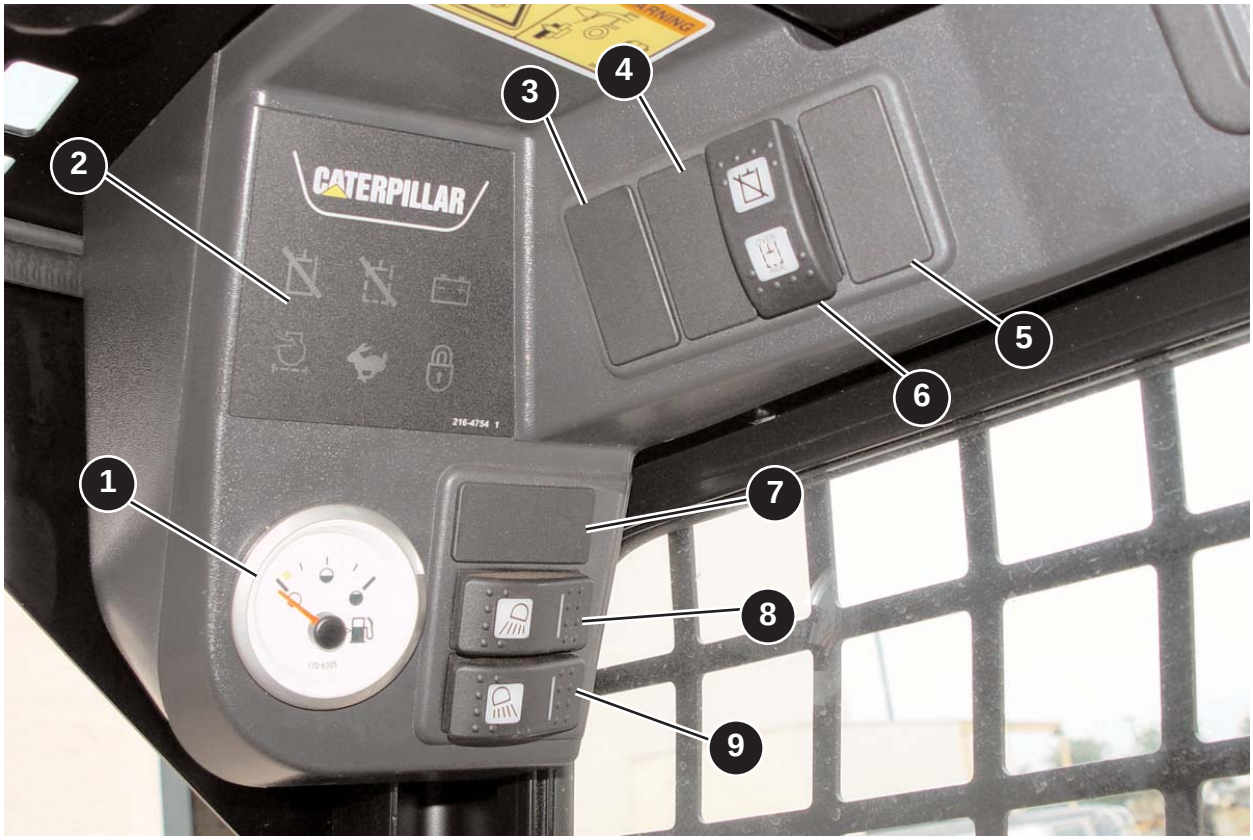
Glow plug starting aid (8) – If the engine is to be started at temperatures below 0°C (32°F), depress the glow plug starting aid after turning the engine key start switch to the ON position. Hold the glow plug starting aid switch for 10 seconds and then turn the key to the START position. After the engine starts, continue to depress the glow plug switch until the engine runs smoothly.

Parking brake control (9) – Depress the right side of the momentary rocker switch to engage or release the parking brake.

Auxiliary hydraulic mode (10) – Depress the left side of the switch to enable the high flow hydraulic system.

> ***NOTE:*** *This illustration may show controls for optional systems that may not be installed on every machine.*

For more information about any of the operator controls, refer to the machine's Operation and Maintenance Manual.



9

This illustration shows the right console which is located in the upper, right corner of the operator's compartment. The right console contains the following components:

Fuel level gauge (1) – The analog fuel level gauge indicates the level in the fuel tank.

Indicator lamps (2) – The right console contains indicator lamps for the hydraulic lockout function, the interlock override function, charging system malfunctions, restricted engine air filter, Rabbit mode, and Machine Security System (MSS) activation.

Roading lights control (3) – Move the switch to the middle position to activate the control panel lights and position lights. Depress the bottom of the switch to turn on the front low beams. Depress the top of the switch to turn off all of the lights.

Hazard flashers control (4) – Depress the top of the switch to activate the hazard flashers.

Beacon switch (5) – Depress the bottom of the switch to activate the beacon light.

Hydraulic lockout and Interlock override (6) – Depress the top of the switch to disable the machine's hydraulic functions. Depress the top of the switch again to enable the machine's hydraulic functions.

The interlock override allows the auxiliary hydraulic circuits (A1 or A2) to function with the armrest in the RAISED position and the seat unoccupied. Depress the bottom of the switch after activating the continuous flow function. On machines equipped with the optional door, an electrical jumper must be installed to bypass the door switch.

Turn signals (7) – Depress the left side of the switch to activate the left turn signals or depress the right side of the switch to activate the right turn signals. Move the switch to the center position to turn off the turn signals.

Front work lights (8) – Depress the left side of the switch to turn on the lights.

Rear work lights (9) – Depress the left side of the switch to turn on the lights.

10

The speed and direction control lever (1) is located on the left side of the operator's compartment. The speed and direction control lever controls the forward and reverse and left and right direction of the machine. The control lever has five positions: FORWARD, REVERSE, HOLD, LEFT, and RIGHT.

The work tool control lever (2) controls the lift arms and work tool tilt functions. The work tool control lever is moved forward and rearward to lower and raise the lift arms. The work tool control lever is moved left and right to tilt the work tool. The control lever has six positions: RAISE, LOWER, HOLD, FLOAT, TILT FORWARD, and TILT BACK.

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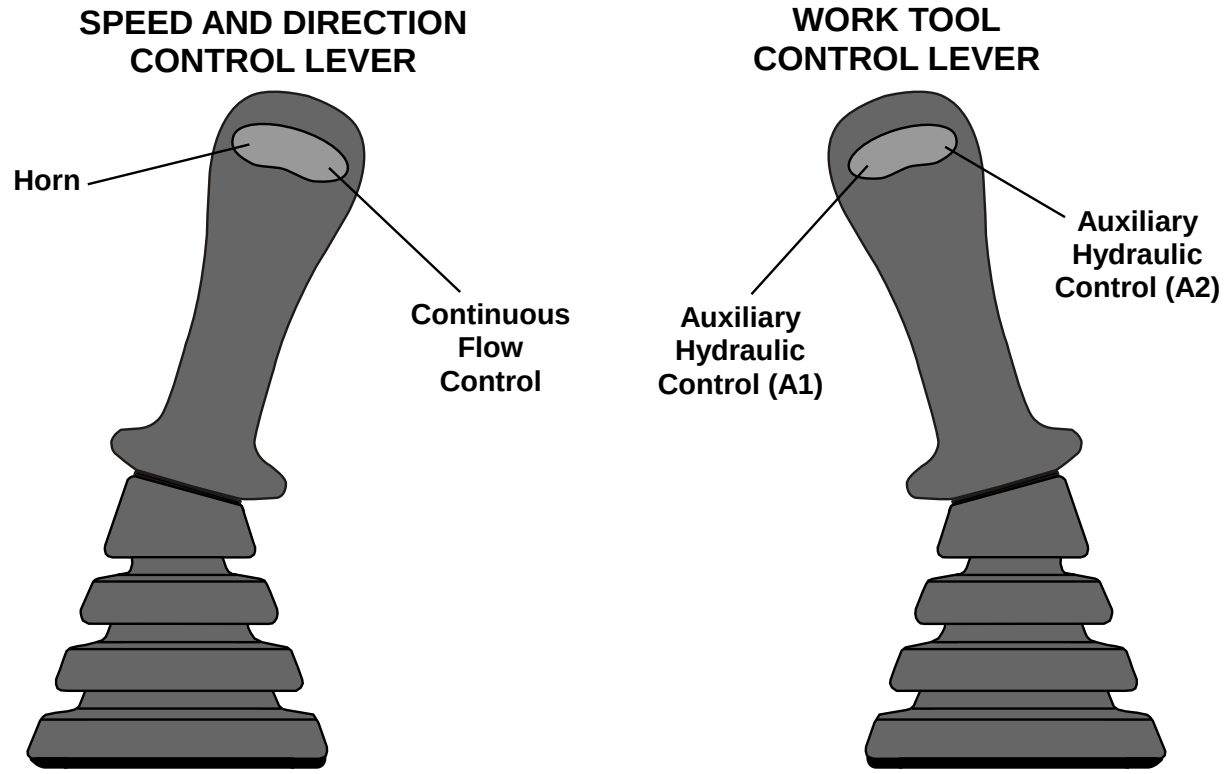
The governor control lever (1) is located on the right side of the operator's compartment in front of the work tool control lever (2). The governor control lever is used to set the engine speed.

Engine speed is also controlled by the accelerator pedal (not shown). The accelerator pedal is located on the right side of the floorplate. Depressing the accelerator pedal will increase engine speed. Releasing the accelerator pedal will return the engine speed to the governor setting.

STANDARD CONTROL LEVER SWITCH FUNCTIONS



12

Each of the standard control levers have two switches at the top. The left switch on the work tool control lever activates the "A1" auxiliary hydraulic function. The right switch on the work tool control lever activates the "A2" auxiliary hydraulic function.

The left switch on the speed and direction control lever controls the horn. The right switch on the speed and direction control lever activates the continuous flow control. The continuous flow feature is used to maintain a constant flow from the auxiliary circuit without requiring the operator to continuously operate the "A1" or "A2" switch. To use the continuous flow function, depress and hold the "A1" or "A2" switch. Then, while holding the "A1" or "A2" switch, depress and release the continuous flow switch. Release the "A1" or "A2" switch within one second of releasing the continuous flow switch.

NOTE: *When the "A1" circuit is activated auxiliary hydraulic oil flows to the work tool through the top auxiliary quick disconnect coupler and returns to the machine through the top auxiliary quick disconnect coupler. When the "A2" circuit is activated auxiliary hydraulic oil flows to the work tool through the bottom auxiliary quick disconnect coupler and returns to the machine through the bottom auxiliary quick disconnect coupler.*

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Machines equipped with high flow hydraulics or proportional auxiliary hydraulics use different control levers. This illustration shows the work tool control lever (6) on a 268B Skid Steer Loader. The thumb switch (1) controls the proportional auxiliary hydraulics or the high flow auxiliary hydraulics if the auxiliary hydraulic mode switch is in the HIGH FLOW position.

The switches to the right of the thumb switch operate the work tool control circuit found on high flow machines. The top switch (2) activates the "C+" function. The bottom switch (3) activates the "C-" function.

A trigger switch (5) on the front side of the joystick sends an electrical signal to pin B of the work tool electrical connector on the lift arm. This is used to energize a solenoid on a diverter valve on the work tool attachment for different operations.

A film (4) identifies the function of the switches on the control lever.

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The optional speed and direction control lever (7) is shown in this illustration. A film (6) identifies the function of the switches on the control lever.

Some of the switches shown in this illustration include:

- horn (1)

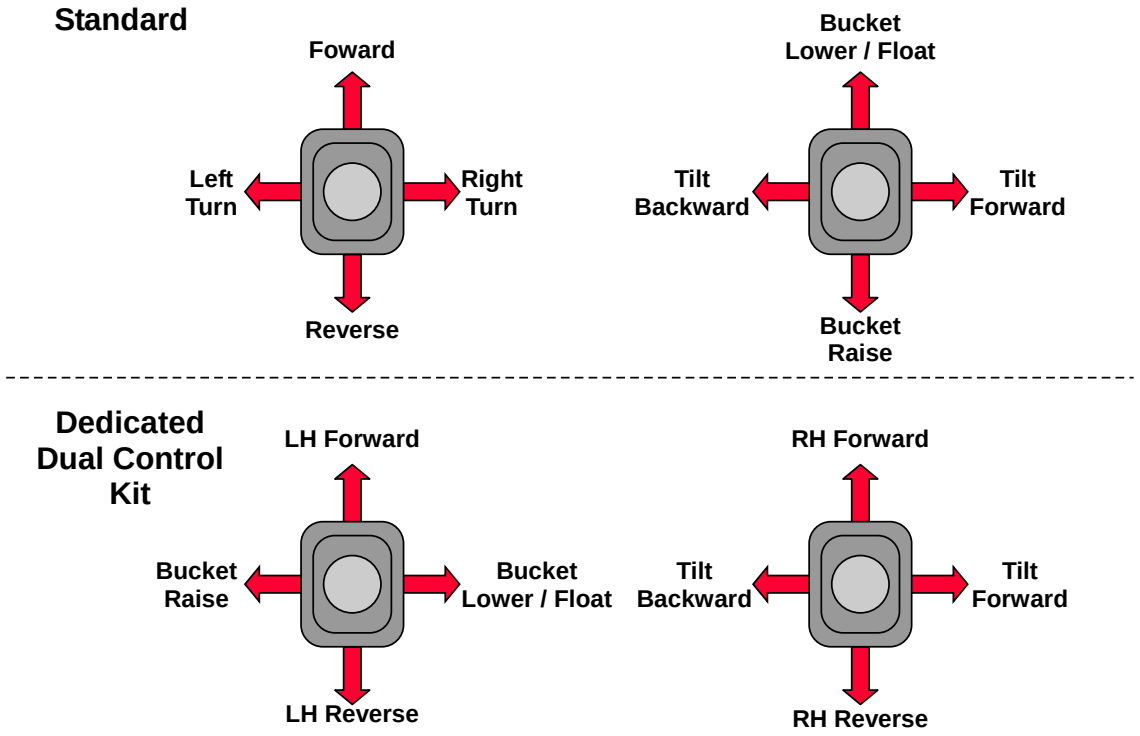
- auxiliary electrical control "C2" (2)

- auxiliary electrical control "C1" (3)

- continuous flow control (4)

- two-speed control (5) (trigger switch on the front side of joystick)

CONTROL LEVER PATTERNS



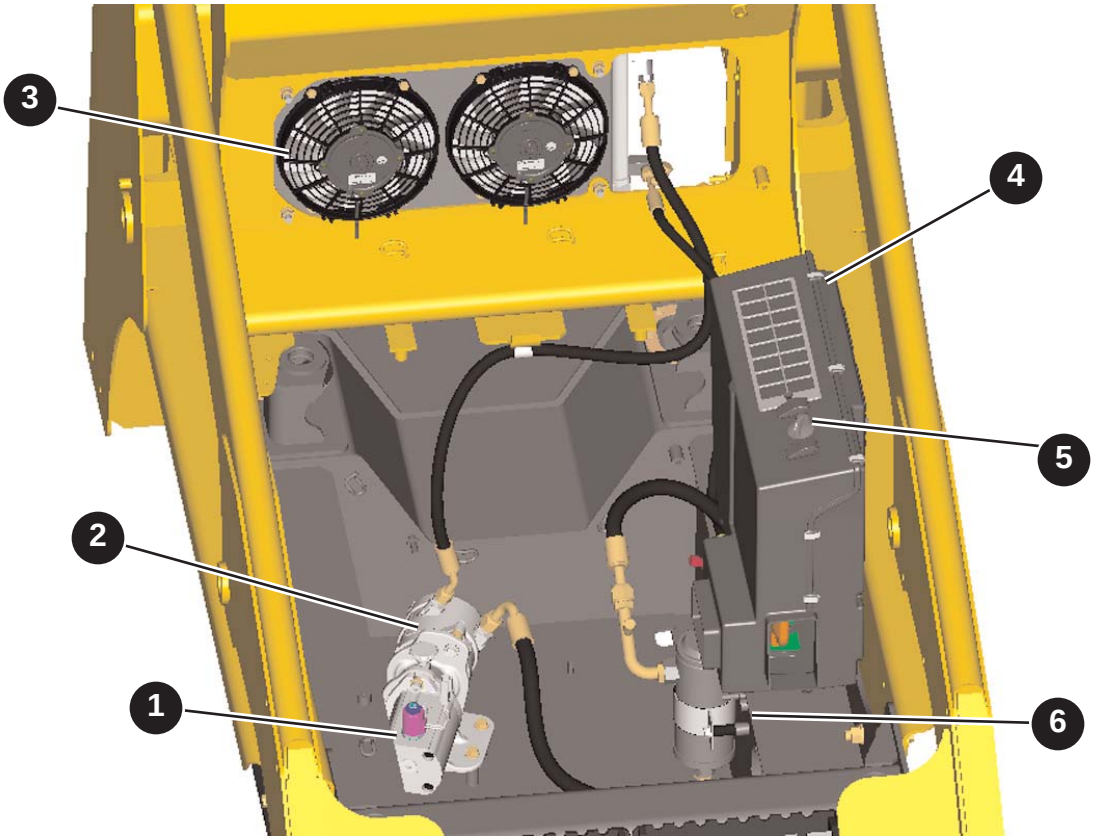
15

Two control patterns are available for the 236B, 246B, 252B, and 262B. The standard pattern is the same pattern used on the former machines. The dedicated dual control kit pattern provides an alternative control pattern with the convenient control and feel of dual control lever steering and work tool controls.

Machines equipped with the dedicated dual control kit retain the anti-stall and bucket float features.

> ***NOTE*:** *The alternate control pattern of dedicated dual control kit is the same pattern used by some competitive machines.*

Films in the operator's compartment identify the installation of the dedicated dual control kit on a machine.



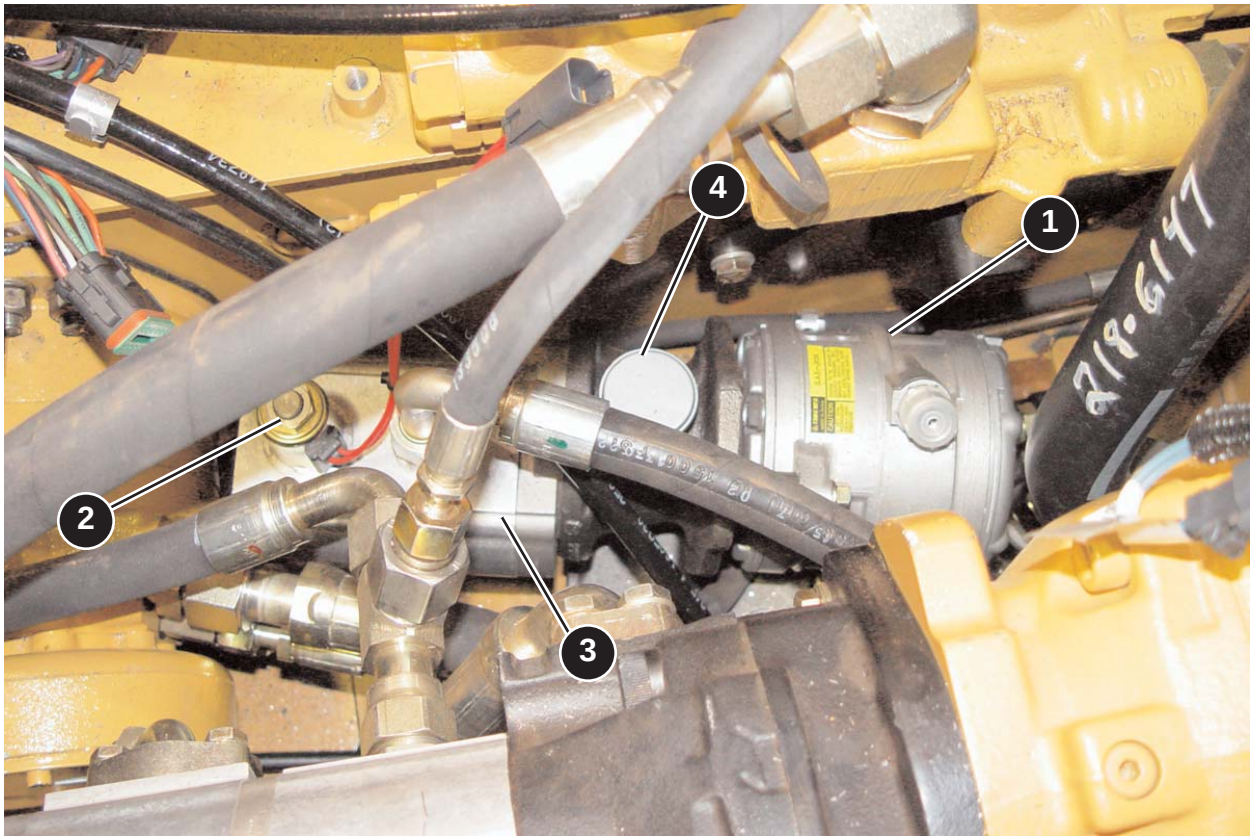
16

This illustration identifies the components of the optional air conditioning system.

The hydraulic motor (1) drives the air conditioning compressor (2). The electrically driven condenser fans (3) force air across the condenser.

The cab filter (4) is located on the left side of the air conditioning system controls (5). The air conditioning system controls (5) are located on the left side of the operator's compartment.

The receiver/dryer (6) is located on the left side of the machine. The charging valves are located on lines near the receiver/dryer.



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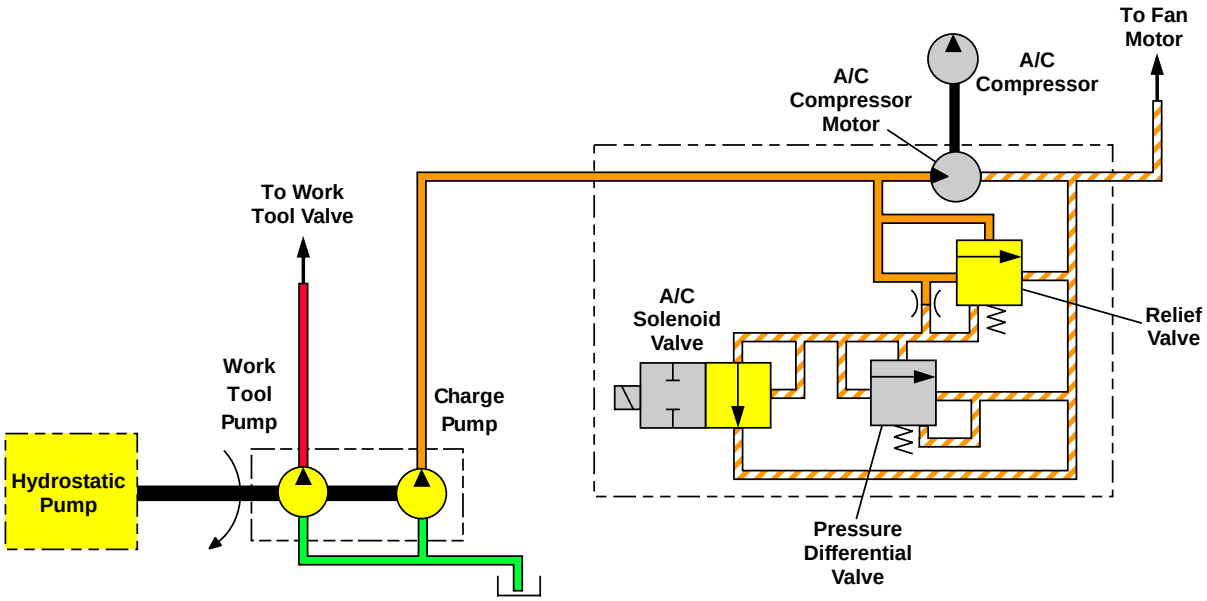
The air conditioning compressor (1) is driven by a hydraulic motor (3). The motor is engaged when the solenoid valve (2) is energized by the air conditioning controls in the cab. The drive coupling housing between the motor and compressor contains a breather (4).

AIR CONDITIONER COMPRESSOR HYDRAULIC SYSTEM
OFF



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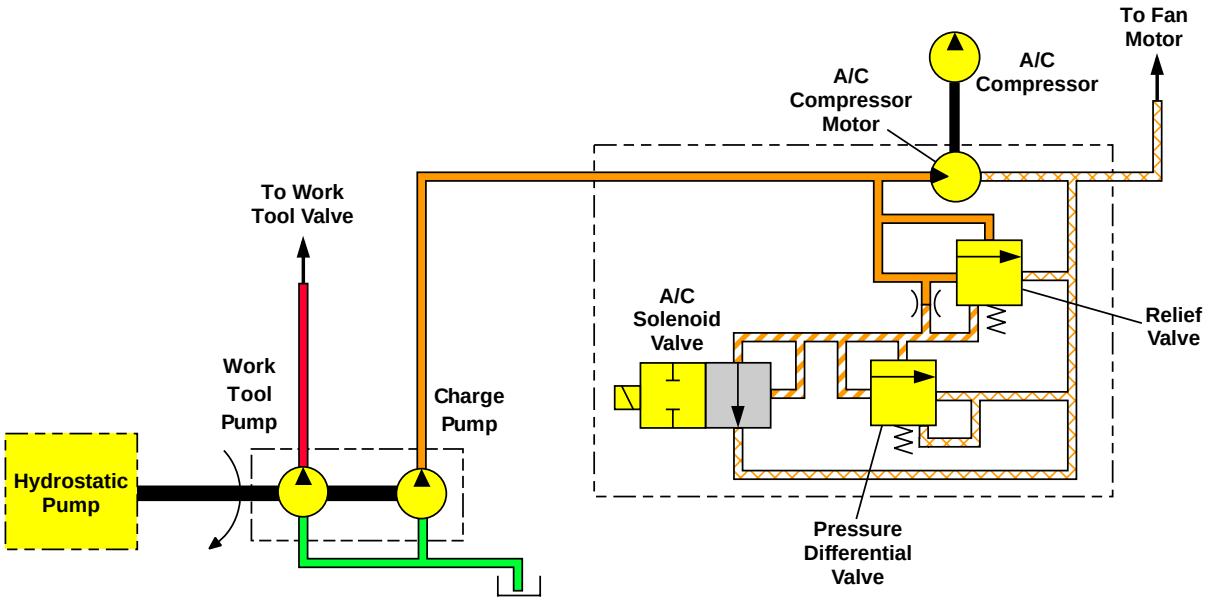
The compressor motor group consists of the air conditioner compressor motor, a relief valve, a pressure differential valve, and the air conditioner solenoid valve. Oil for the air conditioner compressor motor is supplied by the the charge pump.

With the air conditioner solenoid de-energized, the oil coming from the charge pump bypasses the motor through the relief valve. Some of the oil passes through the orifice and flows through the air conditioner solenoid valve.

Oil flowing from the compressor motor group flows to the fan motor.

AIR CONDITIONER COMPRESSOR HYDRAULIC SYSTEM
ON



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When the A/C solenoid valve energizes, the oil flowing from the charge pump through the orifice is blocked at the solenoid valve. The blocked passage causes pressure to rise on the back side of the relief valve, raising the setting of the relief valve. As the relief valve setting rises, pressure from the charge pump increases and oil begins to flow through the motor, causing the motor to rotate.

The pressure differential valve maintains a constant difference of pressure across the AC motor which results in maintaining motor speed.

SKID STEER LOADER AND MULTI-TERRAIN LOADER ENGINE COMPARISON
"B" SERIES VS. PREVIOUS MACHINES

Model	"B" Series Engine	"B" Series Power	% Change
216B	3024C	37 kW (49 hp)	2.1%
226B	3024CT	43 kW (57 hp)	5.6%
232B	3024C	37 kW (49 hp)	2.1%
242B	3024CT	43 kW (57 hp)	5.6%
236B	3044C DIT	52 kW (70 hp)	18.6%
246B	3044C DIT	58 kW (78 hp)	5.4%
248B	3044C DIT	57 kW (76 hp)	2.7%
252B	3044C DIT	52 kW (70 hp)	18.6%
262B	3044C DIT	58 kW (78 hp)	5.4%
268B	3044C DIT	57 kW (76 hp)	
247B	3024CT	43 kW (57 hp)	5.6%
257B	3024CT	43 kW (57 hp)	-3.4%
267B	3044C DIT	52 kW (70 hp)	18.6%
277B	3044C DIT	58 kW (78 hp)	5.4%
287B	3044C DIT	58 kW (78 hp)	5.4%

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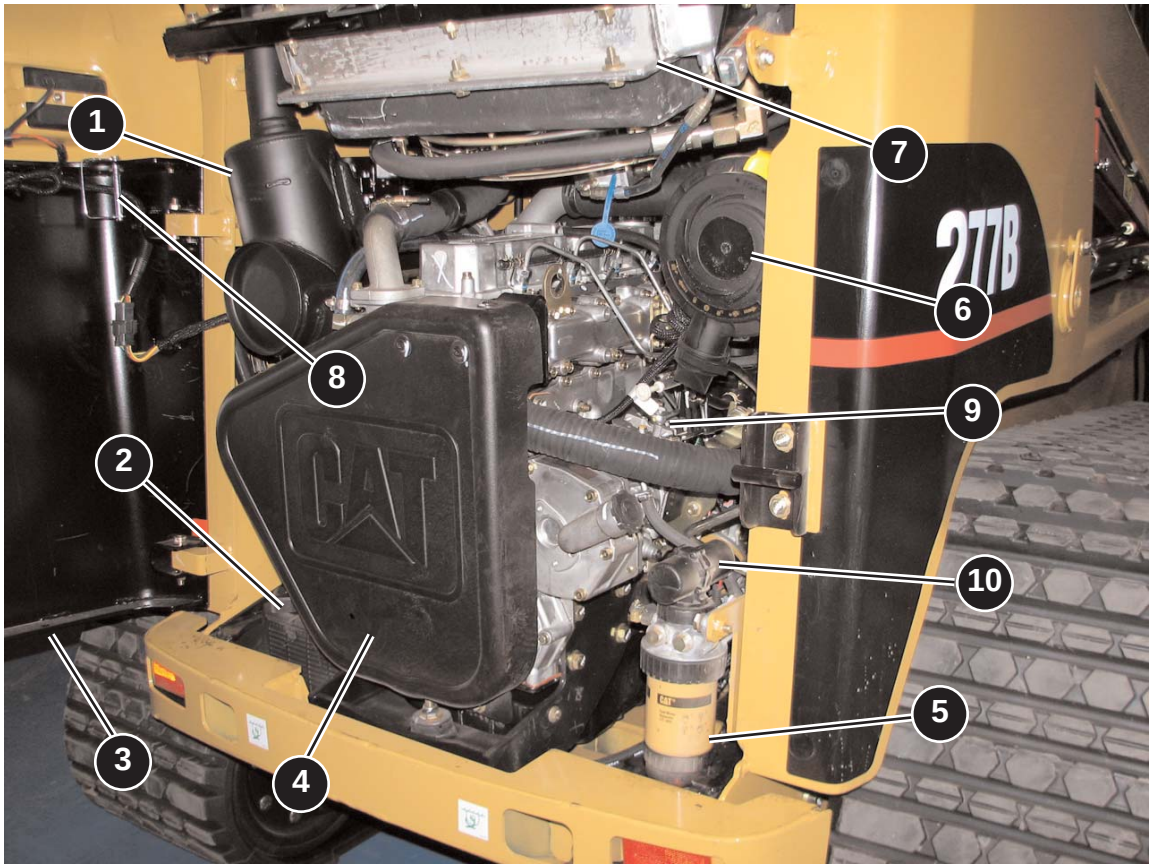
ENGINES

Two engines are used in the "B" Series skid steer loaders and multi-terrain loaders. The 216B and 232B Skid Steer Loaders continue to use the 3024C Engine. The 226B, 242B, 247B, and 257B use a turbocharged version of the 2.2-liter 3024C Engine. The remaining models use the new 3.3-liter, turbocharged 3044 C DIT Engine.

The illustration shows the engine installed in each model. A horsepower comparison between e "B" Series and former machines is also given.

> ***NOTE:*** *For more information about the 3024C, refer to the service manual "3024C Engine for Caterpillar Built Machines" (SENR5005).*

For more information about the 3044C, refer to the service manual "3044C Engine for Caterpillar Built Machines" (SENR9822).



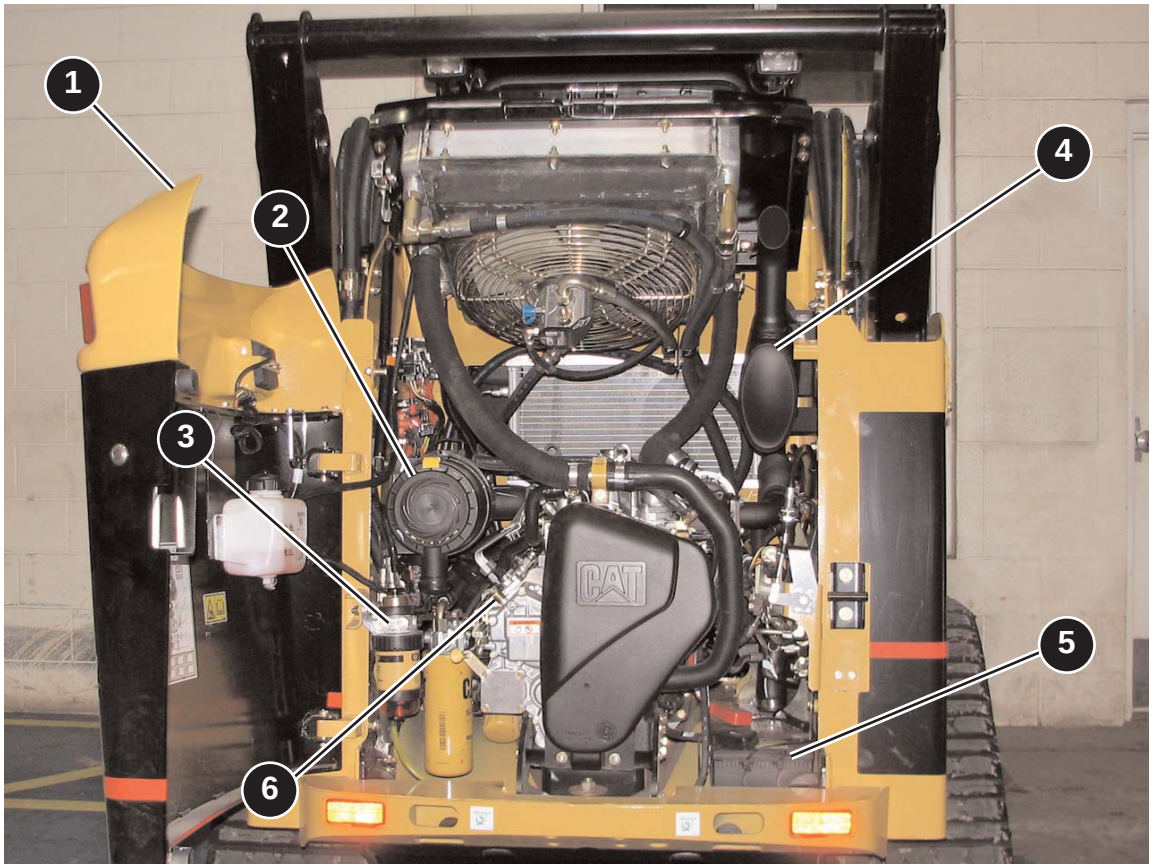
21

This illustration shows the engine compartment of a machine equipped with the Caterpillar 3044C engine. The location of many engine compartment components is different on "B" Series machines equipped with the 3044C from former machines. The engine compartment door (3) opens from the right side of the machine. The door should be secured with the pin (8) to prevent accidental closure while servicing the machine.

The engine belt guard contains an access hole (4) for measuring engine speed. The pulley behind the access hole is equipped with reflective material for use with a photo tachometer.

The fuel filter/water separator (5) contains an electric priming/transfer pump (10). The air cleaner (6) is located on the right side of the engine compartment. The muffler (1) is located on the left side of the machine. The oil cooler/radiator (7) swings upward for better access to the engine compartment. The fuel injection pump and governor (9) are located on the right side of the engine

The battery (2) is located below the muffler. The standard battery has 650 Cold Cranking Amps (CCA). An optional battery with 850 CCA is also available.

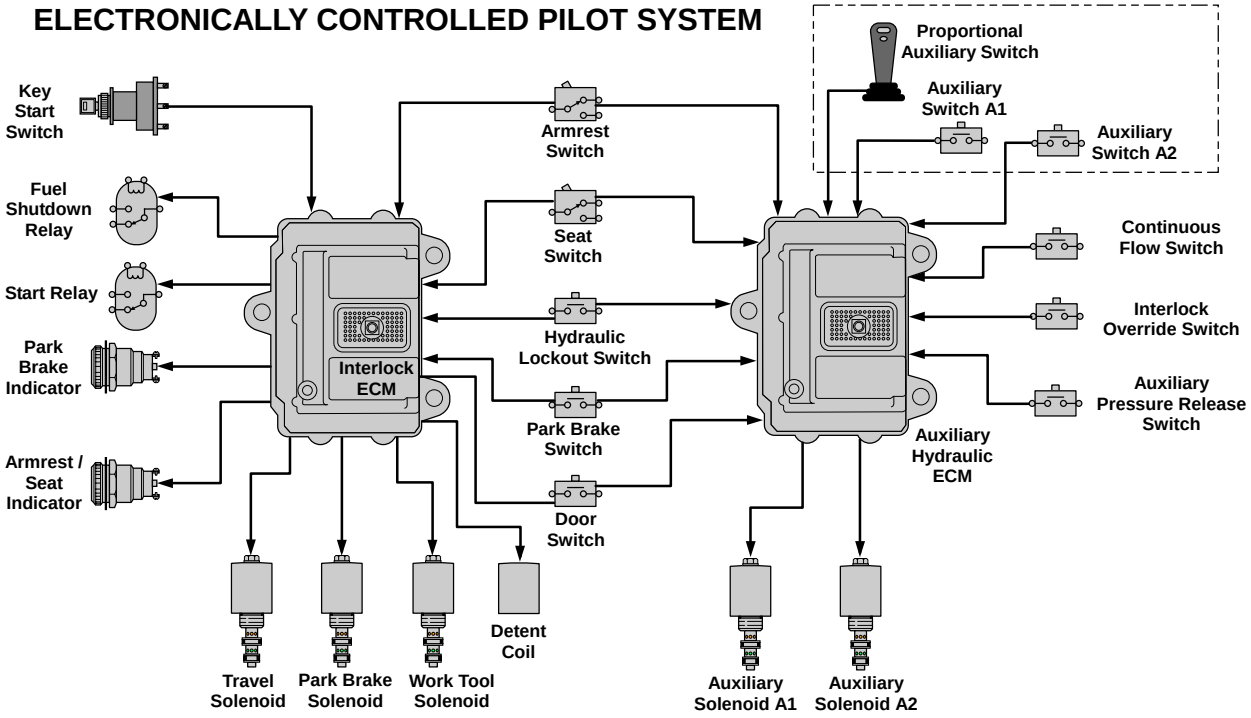


22

This illustration shows the engine compartment on a machine equipped with the Caterpillar 3024C Engine. The position of many engine compartment components is different on machines equipped with the Caterpillar 3024C Engine. The component locations on machines equipped with 3024C Engines are similar to the locations on former machines.

Some of the components shown in this illustration include:

- door (1)
- air cleaner (2)
- fuel filter with manual priming pump (3)
- muffler (4)
- battery (5)
- transfer pump, fuel injection pump, and governor (6)



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ELECTRONICALLY CONTROLLED PILOT SYSTEM

The electronically controlled pilot system controls pilot oil flow to the drive system pilot valves, the drive motor parking brakes, the work tool pilot valves, and the auxiliary control valve spool in the control valve group.

The Operator Interlock Electronic Control Module (ECM) and the Auxiliary Hydraulic Electronic Control Module (ECM) receive input signals from various switches. The control modules process the input signals, make decisions, and provide corresponding output signals.

The Operator Interlock ECM provides output signals to the indicator lamp module, travel solenoid, the parking brake solenoid, and the work tool solenoid.

The Auxiliary Hydraulic ECM provides output signals to the auxiliary hydraulic solenoids, and the two-speed travel solenoid or the high flow solenoid. The Auxiliary Hydraulic ECM communicates through the CAT Data Link and can be accessed with Cat Electronic Technician (Cat ET).

The following three ON/OFF solenoids control the pilot oil flow:

Travel pilot solenoid: Directs pilot oil to the travel pilot valves and is located in the base of the travel pilot valve group.

Parking brake solenoid: Directs pilot oil to release the drive motor parking brakes and is located in a manifold block on the left rail of the machine.

Work tool pilot solenoid: Directs pilot oil to the work tool pilot valves and is located in the base of the work tool pilot valve group.

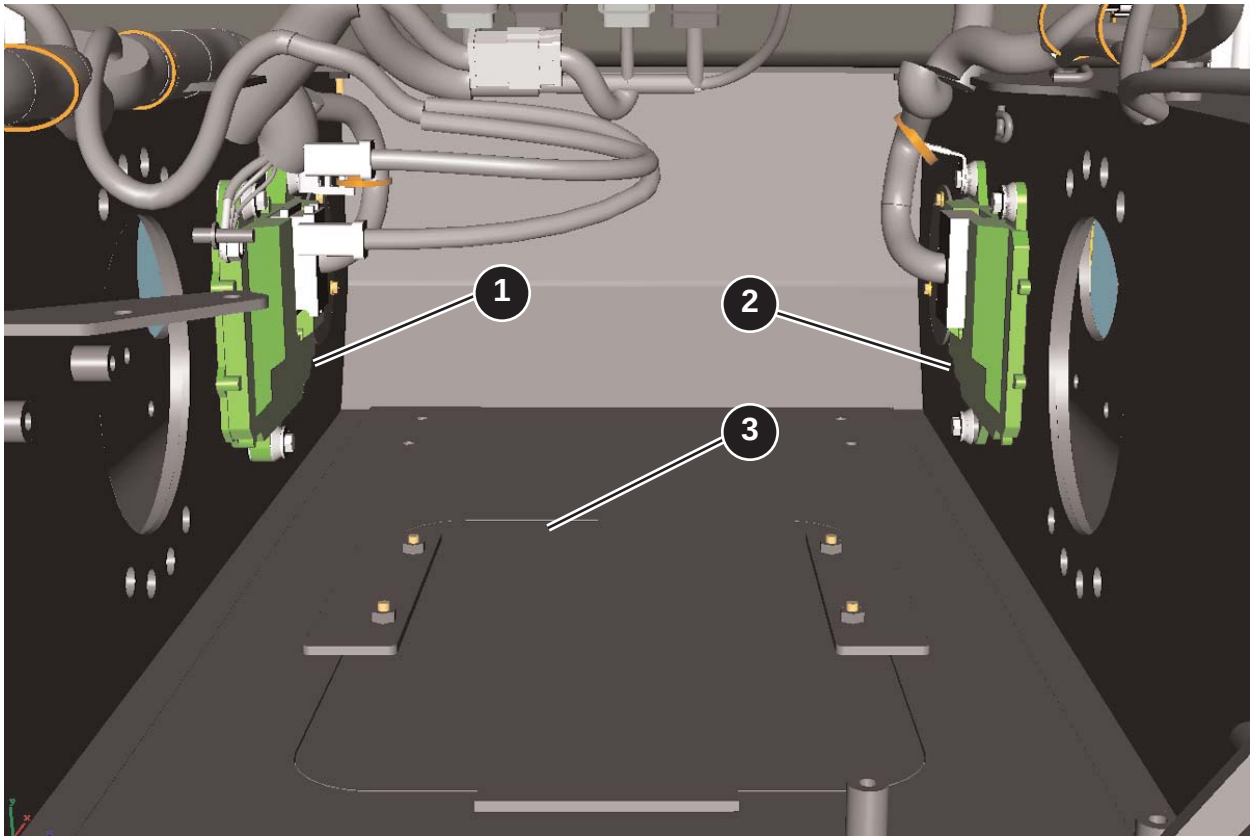
The following solenoids are proportional solenoids that control pilot oil flow to the auxiliary hydraulic control spool.

Auxiliary solenoid "A1": Directs pilot oil to the auxiliary control valve spool in the control valve group.

Auxiliary solenoid "A2": Directs pilot oil to the auxiliary control valve spool in the control valve group.

NOTE: The auxiliary solenoids are proportional solenoids; however, they may function as ON/OFF solenoids. The function of the auxiliary solenoids is determined by the configuration of the Auxiliary Hydraulic ECM.

The Auxiliary Hydraulic ECM also controls the solenoids for the two-speed travel and high flow options. The operation of those solenoid will be discussed with their respective systems.

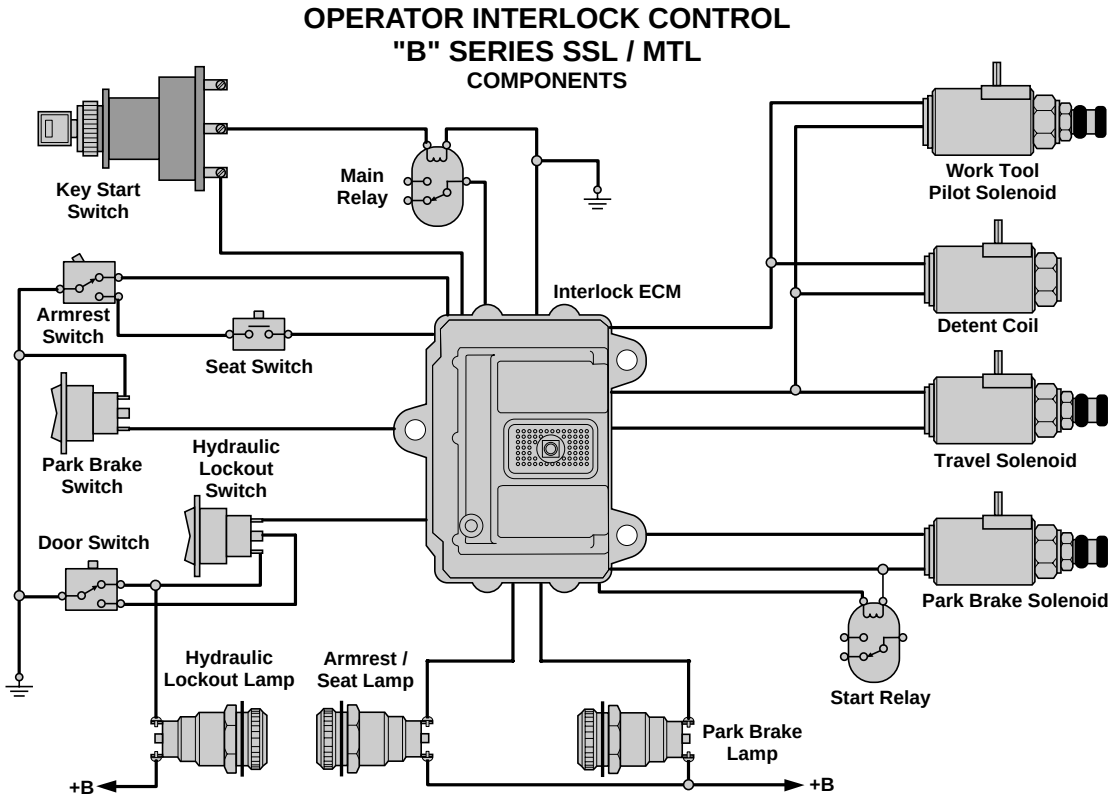


24

The "B" Series Skid Steer Loaders and Multi-Terrain Loaders are equipped with two ECMs as standard equipment. The ECMs on the Skid Steer Loaders are mounted to the inside of the frame at the front of the machine. The ECMs on the Multi-Terrain Loaders are mounted on the frame at the front of the machine or they are mounted to the skid plate of the frame at the front of the machine. The Operator Interlock ECM (1) prevents engine starting, machine travel, and work tool operation until certain conditions are met. The Auxiliary Hydraulic ECM (2) controls the auxiliary hydraulic circuit, the optional two-speed travel system, and the high flow auxiliary hydraulic system.

The ECMs can be accessed from below the machine by removing the access plate (3) or by removing the floorplate in the bottom of the operator’s compartment.

A third ECM is installed on machines equipped with the optional Machine Security System (MSS). This ECM is installed on the rear of the operator’s compartment in the place of the former Interlock ECM.



25

This illustration shows the input and output components used by the Operator Interlock ECM. The Operator Interlock ECM prohibits the engine from starting and de-energizes the travel solenoid valve, the park brake solenoid valve, and the work tool solenoid valve until certain conditions are met.

The Operator Interlock ECM reads the input signals from various switches on the machine. The armrest switch is a normally open switch located at the right hinge point for the armrest. The armrest switch closes when the armrest is lowered. The seat switch is normally open switch that is located below the operator's seat. The seat switch closes when the operator is seated in the seat. The door switch is a normally open switch located on the inside of the door. The door switch closes when the door is closed.

The Operator Interlock ECM determines operator requests from input signals from the key switch, park brake switch, and the work tool lockout switch.

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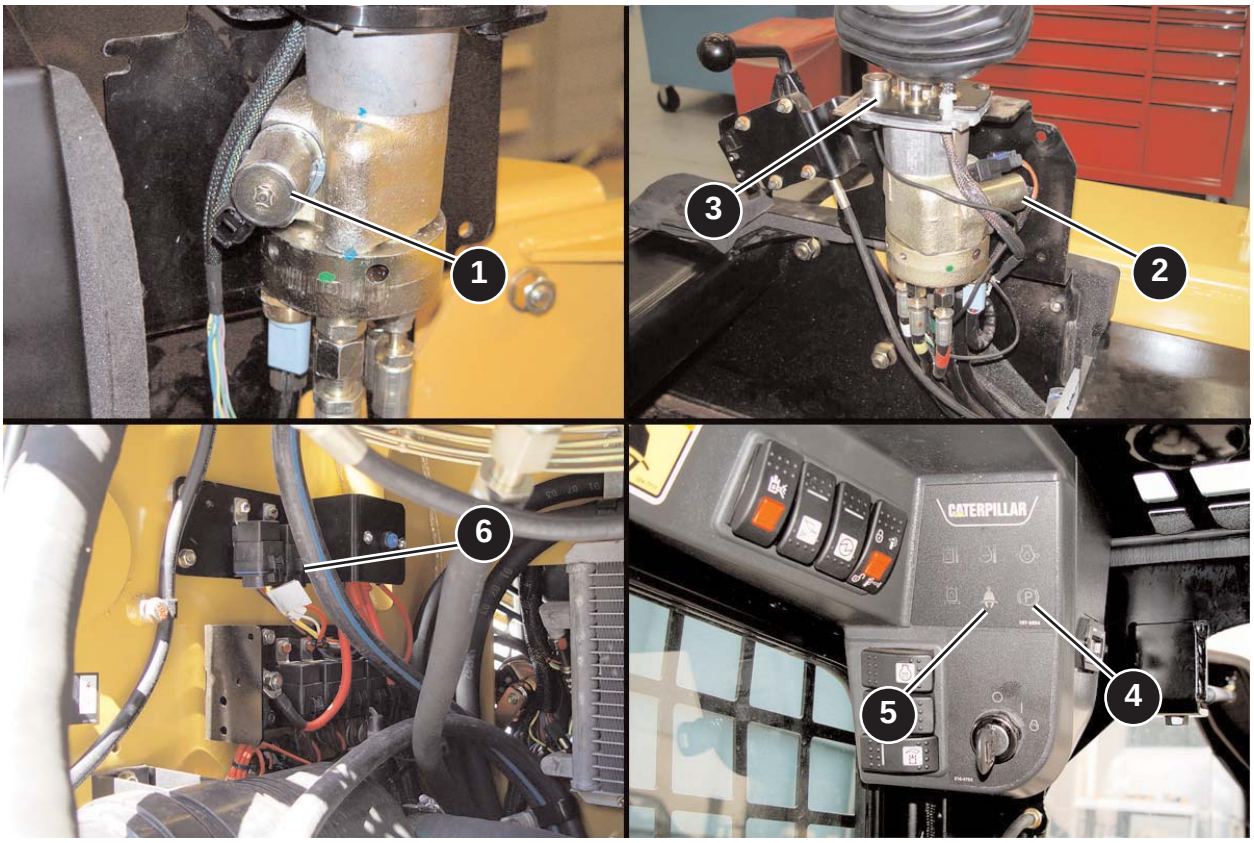
The Operator Interlock ECM receives input signals from the following components:

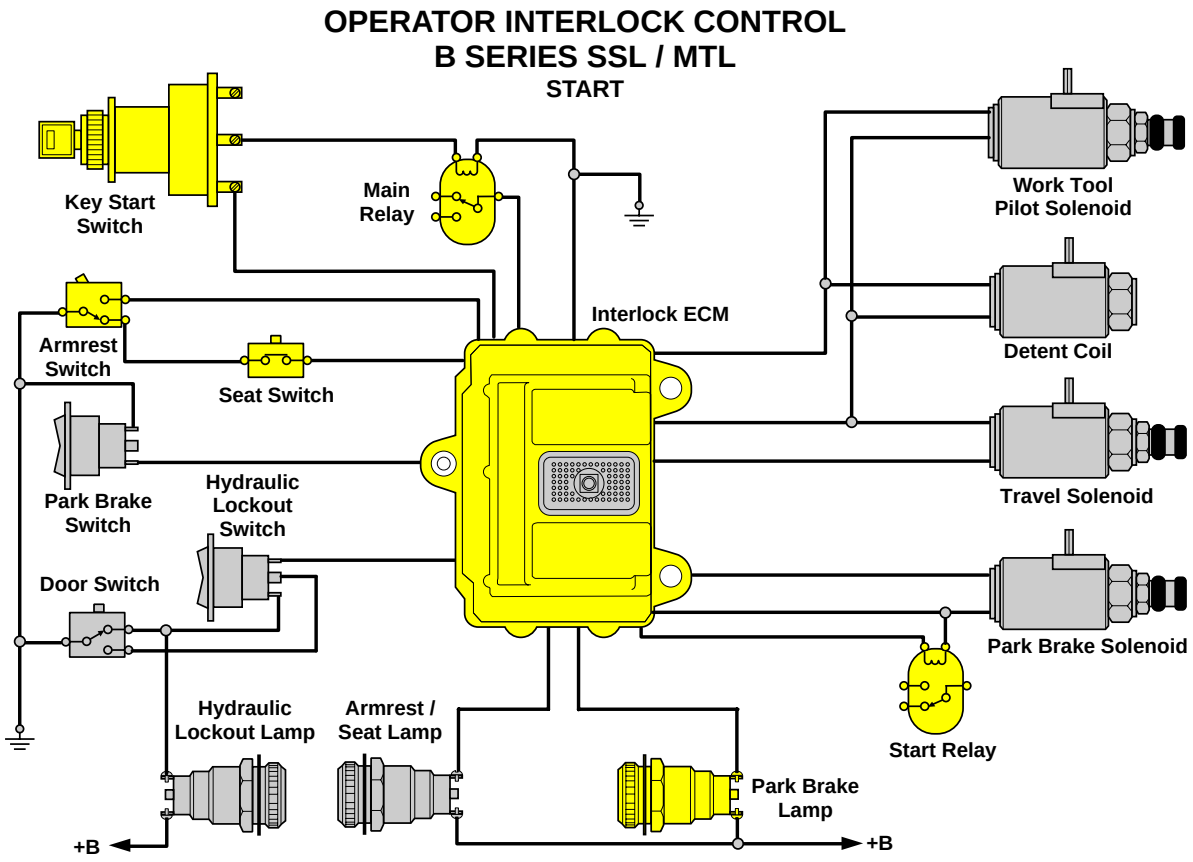
- park brake switch (1) on the left overhead console
- key start switch (2) on the left overhead console
- door lockout switch (3) on the optional door
- armrest switch (4) on the right hinge point for the armrest
- work tool lockout switch (5) on the right overhead console
- seat switch (not visible) located below the seat



27

The Operator Interlock ECM energizes the following components:

- the travel solenoid (1) on the speed and direction pilot valve
- the work tool solenoid (2) on the work tool pilot valve
- the work tool detent coil (3) on the work tool control lever
- park brake indicator lamp (4) on the left console
- armrest/seat indicator lamp (5) on the left console
- start relay (6) on the left side of the engine compartment
- parking brake solenoid (not shown) on the left side of the lower frame

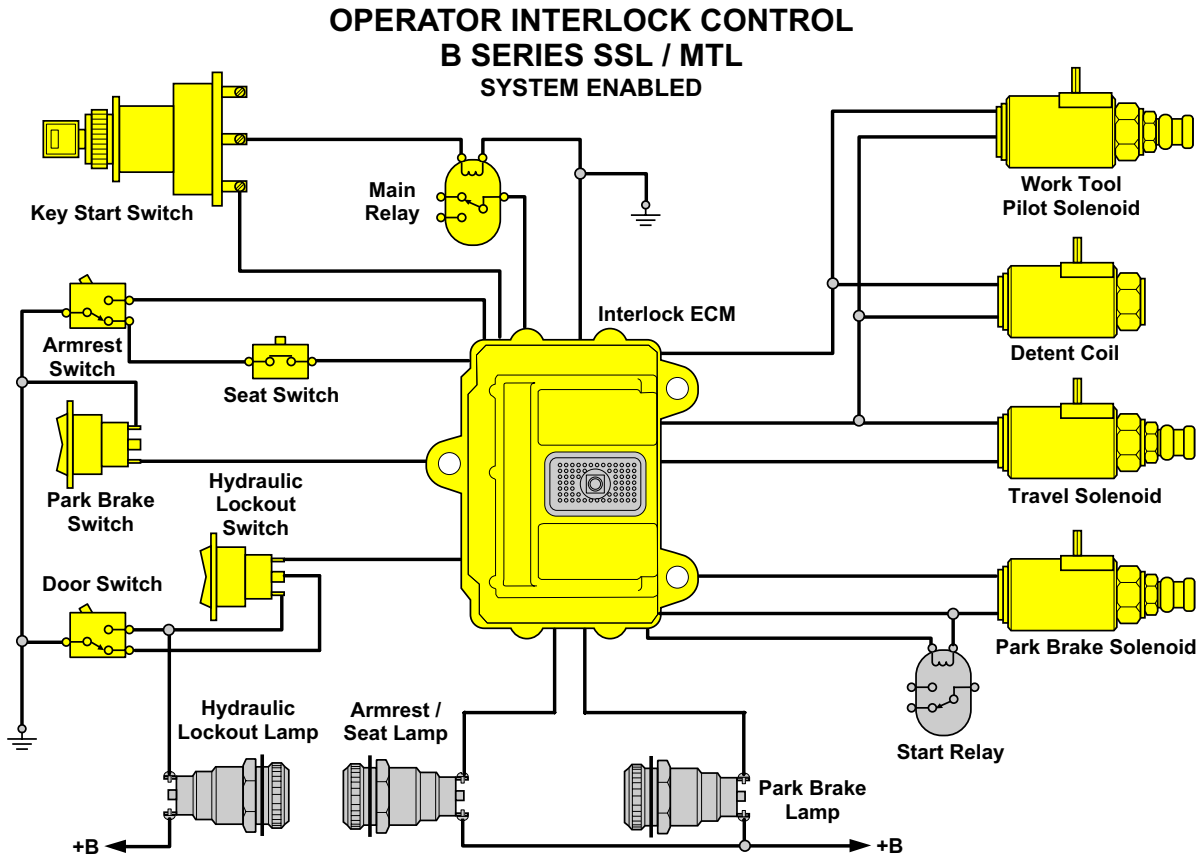


28

The Operator Interlock ECM controls engagement of the starter motor. The start relay is powered by the Operator Interlock ECM when the following inputs are seen: key start switch, armrest switch, and seat switch.

An open circuit on the key start switch input disables machine starting. A short to ground on the key switch input blows a fuse, disabling machine starting. A short to battery on the key start switch input causes the start relay to be continuously energized as long as the armrest switch and seat switch remain in the closed position.

An open circuit or short to ground to the start relay disables machine starting. Shorts to battery in the start relay circuit causes the start relay to be continuously energized, resulting in starter motor damage.



29

The Operator Interlock ECM disables the travel solenoid and park brake solenoid until the operator is seated with the armrest down and the momentary park brake switch is depressed. The travel solenoid allows pilot oil to flow to the speed and direction control lever when energized. The park brake is released by the pilot oil flowing from the park brake solenoid when the solenoid is energized. The park brake indicator lamp is illuminated whenever the parking brake solenoid is de-energized.

The travel solenoid and park brake solenoid are de-energized when the park brake switch is actuated a second time. The solenoids are also de-energized whenever the armrest or seat switches are opened or a failure within the system.

The Operator Interlock ECM disables the work tool hydraulic system until the operator is seated with the armrest down, the door closed, the hydraulic lockout switch off, and the park brake released.

The work tool pilot and travel solenoids are energized, along with the detent coil, by the Operator Interlock ECM when the park brake switch is depressed. Once energized, the work tool pilot solenoid and the detent coil will not be disabled with the park brake switch.

The work tool hydraulic system can be disabled independently of the travel system by depressing the optional hydraulic lockout switch or by opening the operator's compartment door. The work tool pilot solenoid and the detent coil remain energized as long as the hydraulic lockout switch and the door switch remain closed to ground. Opening either of the switches causes the ECM to disable the solenoids. The work tool pilot and detent solenoids are re-energized when both of the switches are closed to ground.

INTERLOCK ECM FAULT DIAGNOSTICS

Component	Fault	Armrest / Seat Indicator	Park Brake Indicator	Park Brake Solenoid	Hydrostatic Solenoid	Work Tool Solenoid	Notes
Armrest / Seat Switch	Open Inputs	Flashing	On	Off	Off	Off	
	Ground Inputs	Flashing	On	Off	Off	Off	
Park Brake Switch	Short to Ground		Flashing	Off	Off		Grounded for 30 Seconds
Park Brake Solenoid	Open Circuit	ECM Dos Not Monitor Solenoid					
	Short to Ground						
	Battery						
Hydrostatic Solenoid	Open Circuit		Flashing	Off	Off		Only Detected When Enabled
	Short to Ground		Flashing	Off	Off		
	Battery	Flashing	Flashing	Off	Off		Only Detected When Disabled
Work Tool Solenoid / Detent Coil	Open Circuit	Flashing				Off	Only Detected When Activated
	Short to Ground	Flashing				Off	Only Detected When Activated
	Battery	Flashing		Off	Off	Off	Functions When Enabled

30

The Operator Interlock ECM monitors the solenoids and switches for opens, shorts to ground, and shorts to battery. The ECM will then flash the armrest indicator and/or the park brake indicator to indicate a problem.

Open circuits and shorts to ground prevent the travel solenoid from energizing, disabling the travel system, and applying the parking brake. The ECM will cause the park brake indicator lamp to flash to signal the operator of the problem. Shorts to battery have different effects depending on the state of system when the fault occurred. If the travel solenoid is commanded OFF when the short to battery occurred, the ECM will open the return line and the travel system is disabled. The ECM will cause the park brake indicator lamp to flash to signal the operator of the problem. If the travel solenoid is requested ON when the short to battery occurs, then the system operates normally.

Open circuits and shorts to ground cause the park brake to be applied. Because the ECM has no indication that the park brake was applied, it may be possible to drive through the park brake, as the transmission remains active. Shorts to battery result in the park brake solenoid being continuously on (brakes released). Because the park brake is spring-applied, the park brake is applied when the machine is electrically turned off.

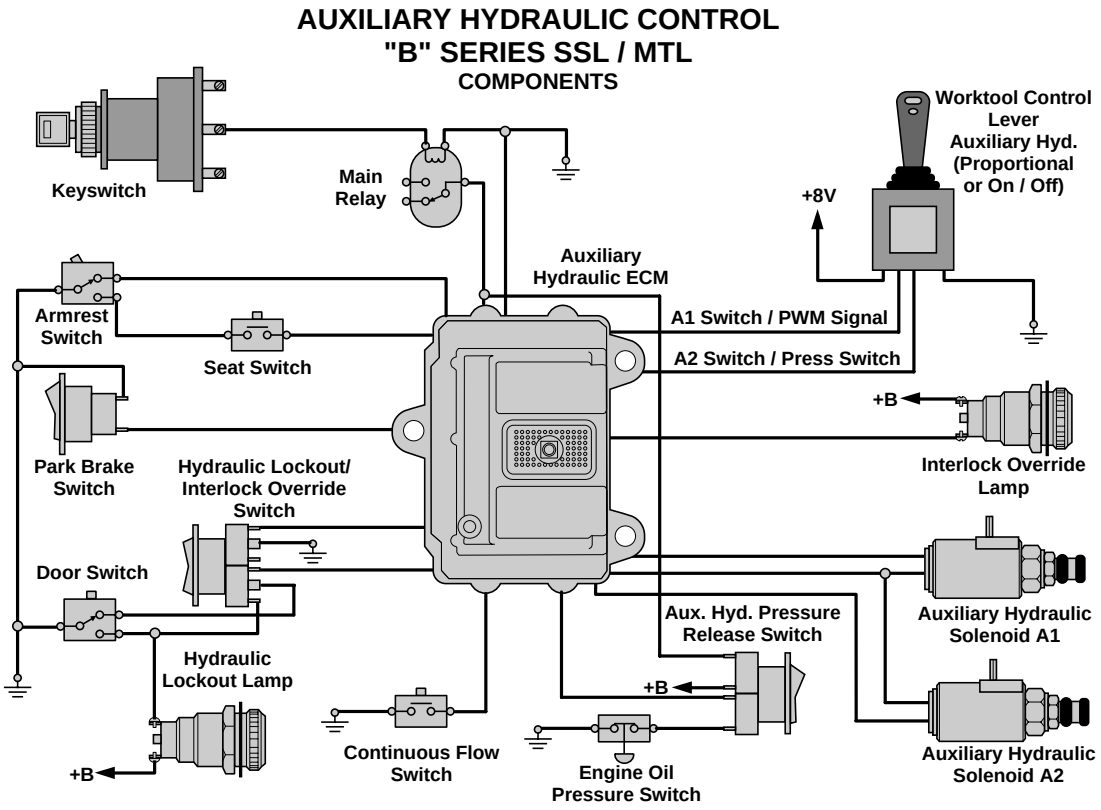
The Operator Interlock ECM monitors the park brake switch for shorts to ground or failed closed conditions. The ECM determines this condition by detecting the signal from the park brake switch being grounded for greater than 30 seconds. The Operator Interlock ECM causes the park brake indicator lamp to flash to signal the operator of the system problem. The indicator lamp flashes immediately if the park brake switch is closed to ground on power-up.

If the Operator Interlock ECM detects both inputs for the seat switch and the armrest switch grounded, the armrest/seat switch indicator lamp will flash to indicate a problem. The machine will start with both inputs closed; however, the travel and work tool systems will be disabled. Additionally, if the ECM detects both inputs are open for more than 5 seconds, the armrest/seat switch indicator lamp will flash and the travel and work tool systems will be disabled.

The Operator Interlock ECM monitors the park brake switch for shorts to ground or failed closed conditions. The ECM determines this condition by detecting the signal from the park brake switch being low for greater than 30 seconds. The Operator Interlock ECM causes the park brake indicator lamp to flash to signal the operator of the system problem. The indicator lamp flashes immediately if the park brake switch is closed to ground on power-up.

The Operator Interlock ECM monitors the work tool pilot solenoid and detent coil for open circuits, shorts to battery, and shorts to ground. The ECM cannot distinguish between the work tool pilot solenoid and detent coil because they are wired in parallel. Open circuits and shorts to ground will prevent the coils from energizing. Shorts to battery has different effects depending on the state of the system when the fault occurred. If the solenoids are requested OFF with a short to battery, the ECM will open the return line, resulting in the disabling of the work tool and travel systems and the engagement of the parking brake. The armrest/seat switch indicator lamp flashes to signal the operator of the problem. If the solenoids are requested on, the work tool hydraulic system functions normally.

A failure of the hydraulic lockout switch or the cab door switch in the open position prevents the switch from enabling the work tool hydraulic system. The work tool hydraulic system remains inactive, regardless of the switch position. This condition may be indicated by the lockout indicator lamp remaining on.



31

This illustration shows the input and output components used by the Auxiliary Hydraulic ECM.

The Auxiliary Hydraulic ECM prohibits the auxiliary hydraulics until certain conditions are met.

The Auxiliary Hydraulic ECM shares the following input signals with the Interlock ECM: armrest switch, seat switch, park brake switch, door switch, and hydraulic lockout switch. The Auxiliary Hydraulic ECM monitors these inputs along with the auxiliary hydraulic control switch(es) in order to energize the auxiliary hydraulic solenoids.

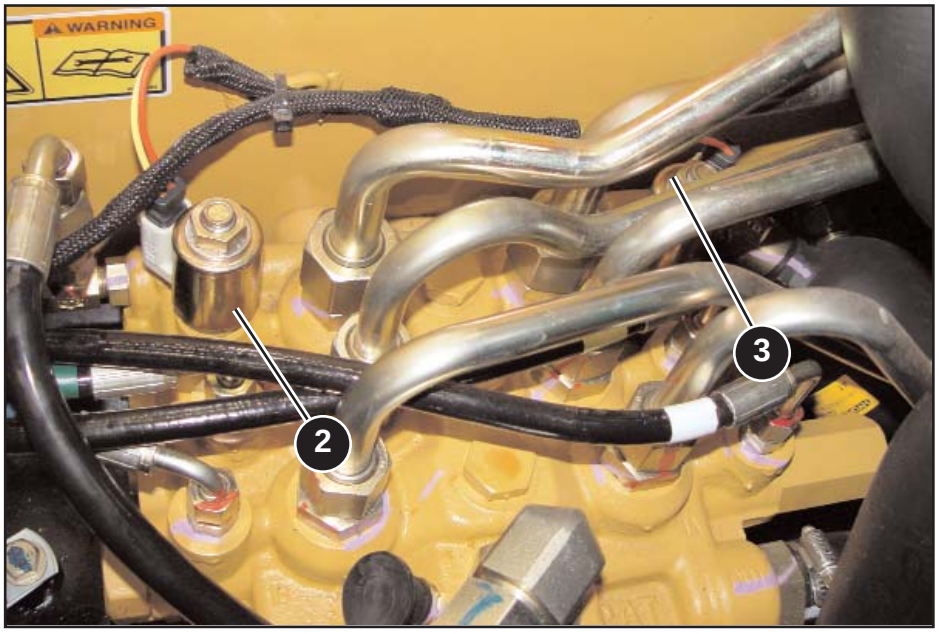
> ***NOTE*:** *The operation of the Auxiliary Hydraulic ECM for the high flow auxiliary hydraulic systems and the two-speed travel option will be discussed with their respective systems.*

32

The Auxiliary Hydraulic ECM receives input signals from the following components:

- the auxiliary hydraulic pressure release switch (1) on the left overhead console
- the auxiliary hydraulic mode switch (2) on the left overhead console
- the interlock override switch and hydraulic lockout switch (3) on the right console
- the continuous flow switch (4) on the speed and direction control lever
- the "A1"/"A2" switch(es) (5) on the work tool control lever

33

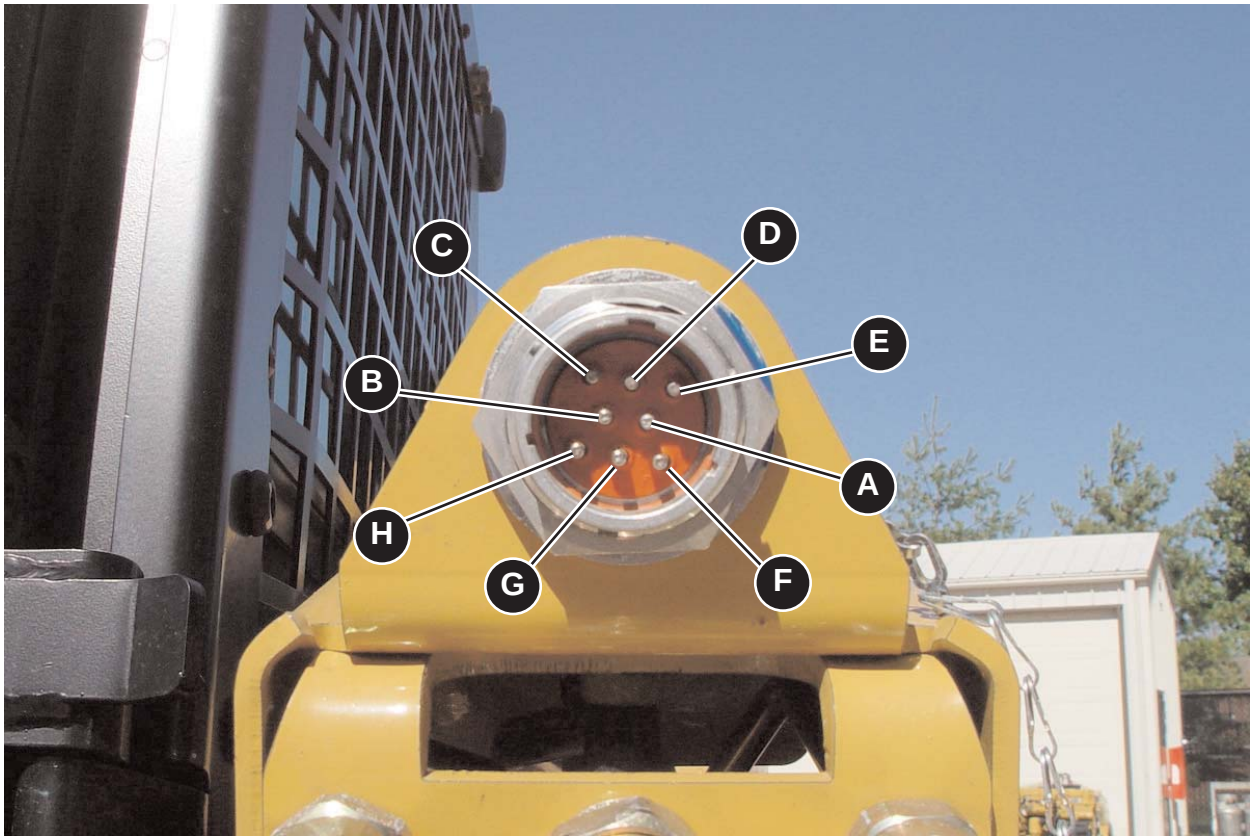


34

The Auxiliary Hydraulic ECM energizes the following components:

- the interlock override indicator lamp (1) on the right overhead console

- the "A1" solenoid (3) and the "A2" solenoid (2) on the work tool control valve



35

The optional work tool electrical connector is located on the left lift arm. The descriptions of the pins for the work tool electrical connector are as follows:

Ground (A) and (E)

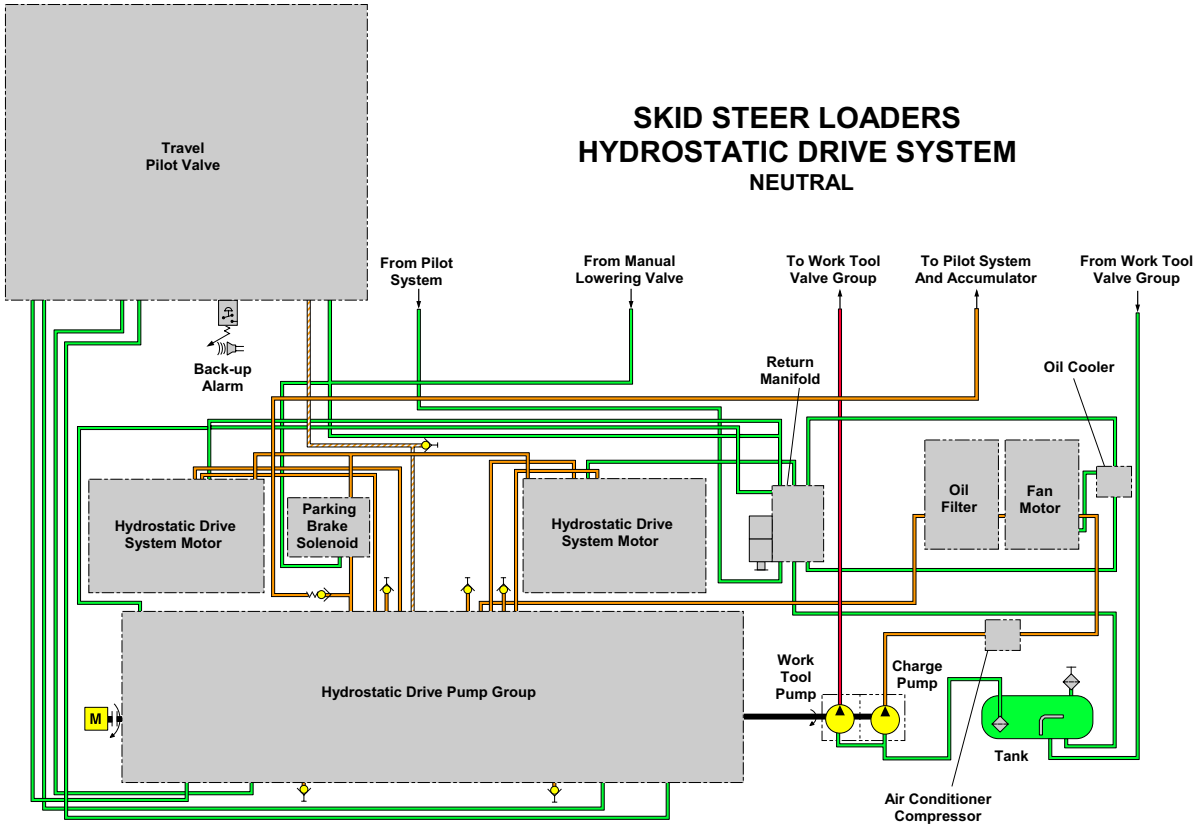
Work tool control lever trigger (B) – Pin B is controlled by the trigger switch on the front of the work tool control lever. Depress the trigger switch to energize pin B.

Auxiliary electrical control C1 (C) – Pin C is controlled by the upper right switch on the optional speed and direction control lever.

Auxiliary electrical control C2 (D) – Pin D is controlled by the lower right switch on the optional speed and direction control lever.

Continuous auxiliary electrical (H) – Pin H is controlled by the auxiliary power rocker switch in the left console. Power is also available to the work tool water pump connector when pin H is energized.

High Flow (F) and (G) – Pins F and G must be connected to enable the high flow systems. A jumper is installed on the "B" series work tools.



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POWER TRAIN

The power train for a skid steer loader includes a hydrostatic drive system which provides power to propel and turn the machine. The hydrostatic system includes a tandem pump group consisting of two rotating groups and two hydrostatic drive motors. Each rotating group has a set of pistons and barrels utilizing one common driveshaft. The individual rotating groups control a hydrostatic drive motor.

The motors transfer power to drive chains on each side of the machine. The drive chains transfer power to the wheel spindles and tires.

The hydrostatic drive system shares a hydraulic tank, oil filter, and oil cooler with the work tool hydraulic system.

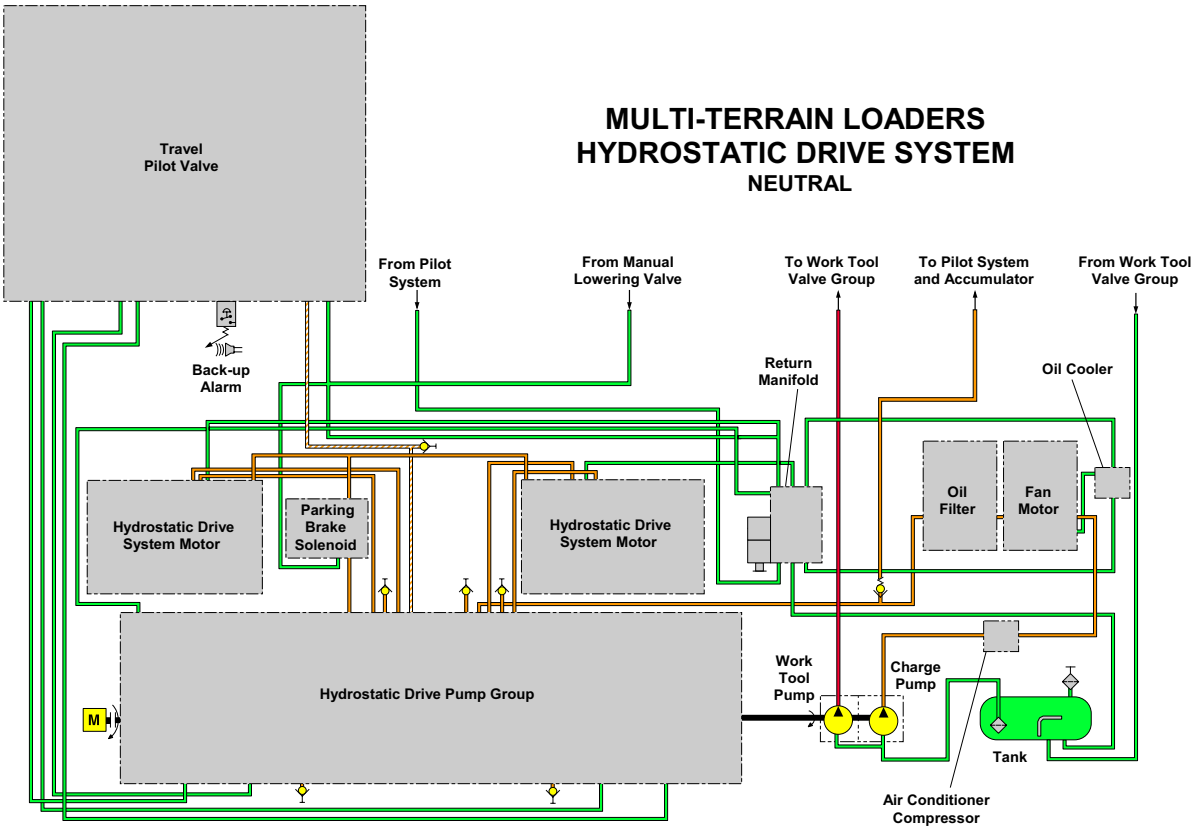
The hydrostatic drive system consists of the following components:

Hydrostatic drive system pump: The pump consists of two rotating groups which are variable displacement, over-center groups that provide oil flow to drive two bi-directional piston motors.

Charge pump: A gear pump provides oil to the pilot valves, speed sensing valve, pump controls, air conditioner compressor, and fan motor and also provides makeup oil for the closed-loop circuit.

Hydrostatic drive system motors: The bi-directional, fixed-displacement, radial piston motors turn the drive sprockets to propel and turn the machine.

Park brake: The parking brakes are a spring engaged, hydraulically released brake and are located in the hydrostatic drive motors to prevent the machine from moving.

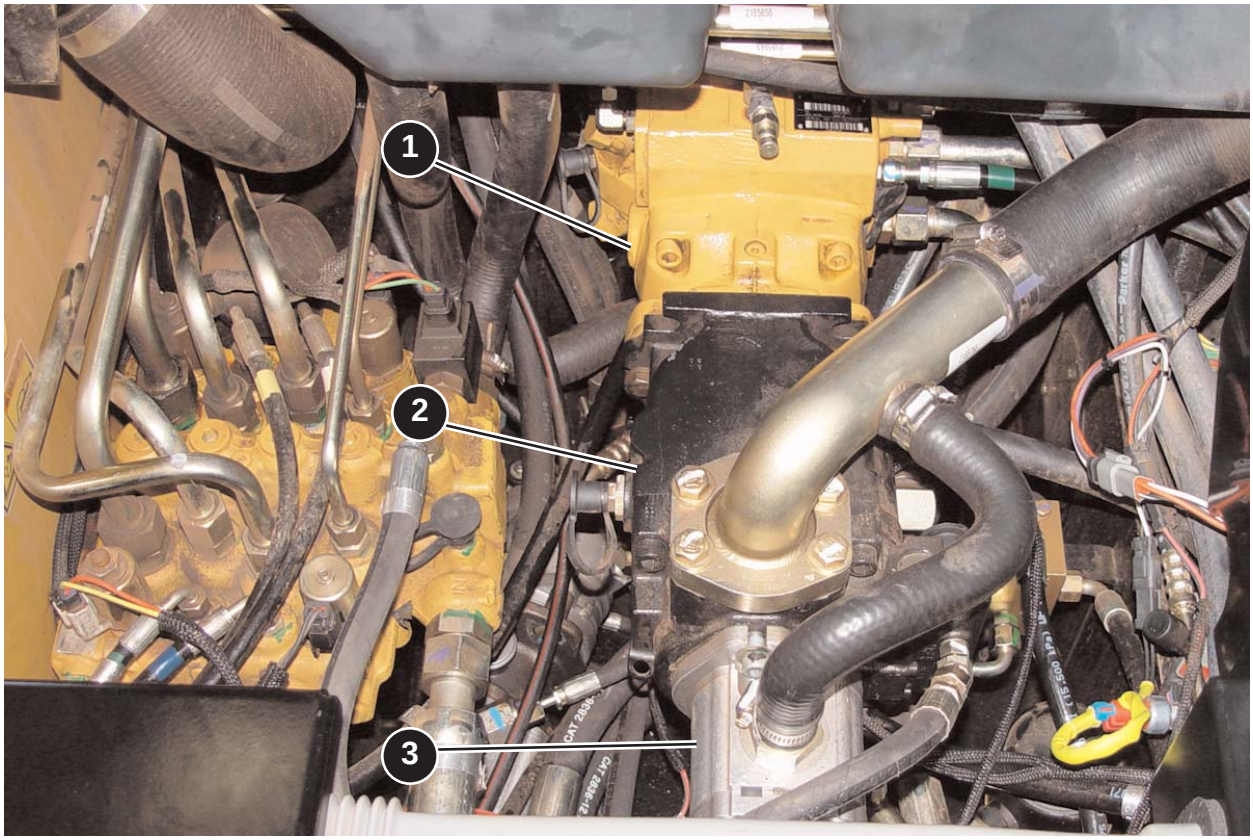


37

The power train for a Multi-Terrain Loader includes a hydrostatic drive system which provides power to propel and turn the machine. The hydrostatic system includes a tandem pump group consisting of two rotating groups and two hydrostatic drive motors. Each rotating group has a set of pistons and barrels utilizing one common driveshaft. The individual rotating group controls a hydrostatic drive motor.

The hydrostatic drive motors are mounted to the Maximum Traction and Support System (MTSS) rubber track undercarriage on each side of the machine.

The hydrostatic drive system shares a hydraulic tank, oil filter, and oil cooler with the work tool hydraulic system.

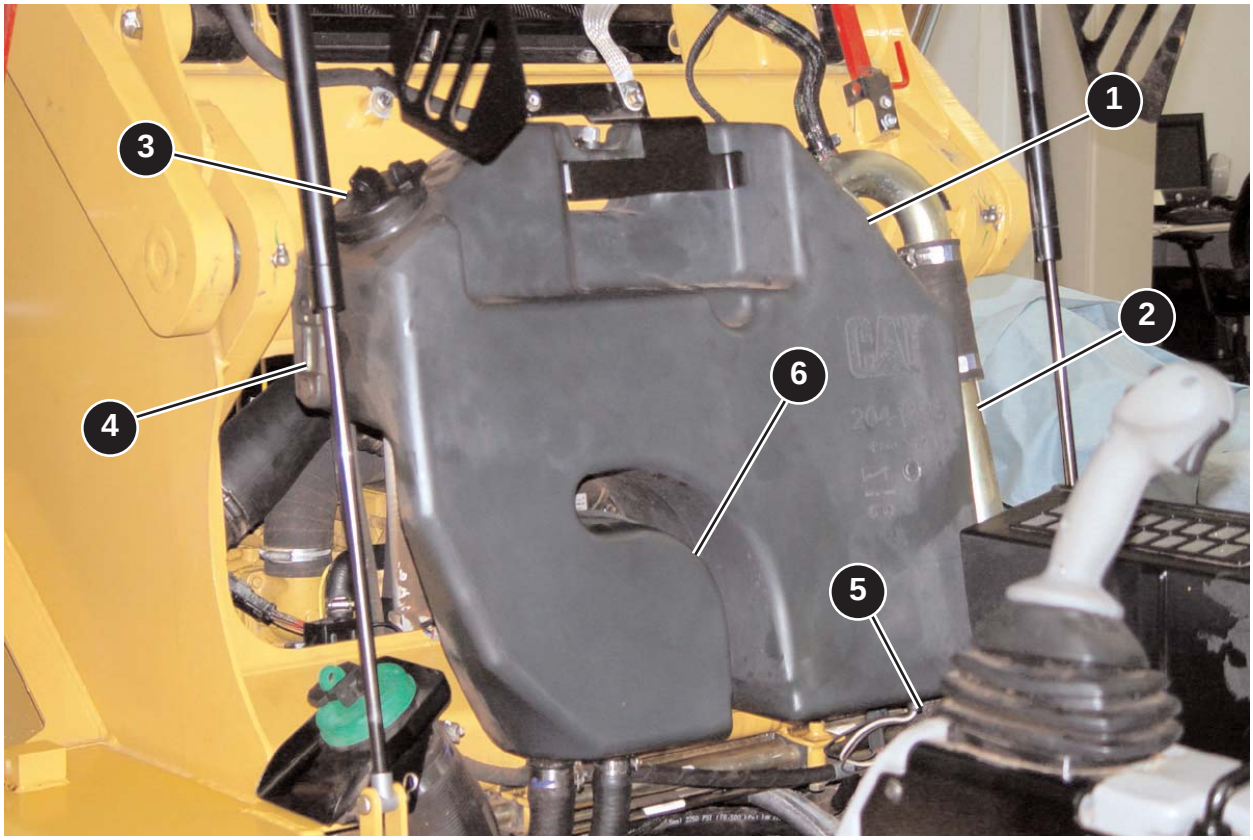


38

Component Locations

On all models of skid steer loaders and multi-terrain loaders, the variable displacement hydrostatic drive pump (1) provides oil flow to the hydrostatic drive motors. The charge pump (3) provides oil flow to the hydrostatic pump, fan motor, and pilot system.

Also shown in this view is the variable displacement work tool pump (2) which provides flow to the XPS High Flow auxiliary hydraulic system on the 248B and 268B Skid Steer Loaders.



39

The hydraulic tank (1) stores oil for the hydrostatic drive system and the work tool hydraulic system.

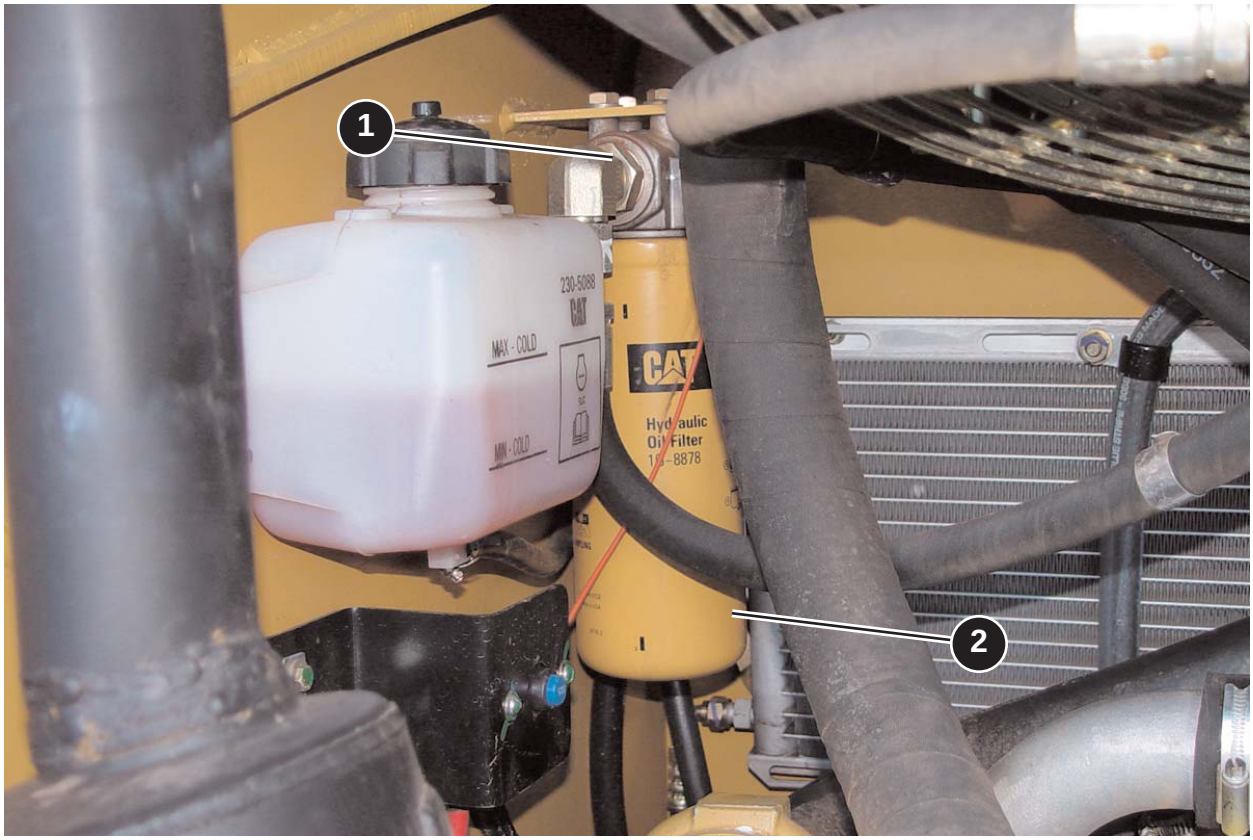
Hydraulic oil is pulled from the tank through the outlet hose (2).

The oil fill cap (3) is located at the top of the tank on the right side.

The sight glass (4) is located below the fill cap.

A Hydraulic Temperature Sensor (5) signals the Hydraulic Temperature Indicator on the left console when the oil is above operating temperature.

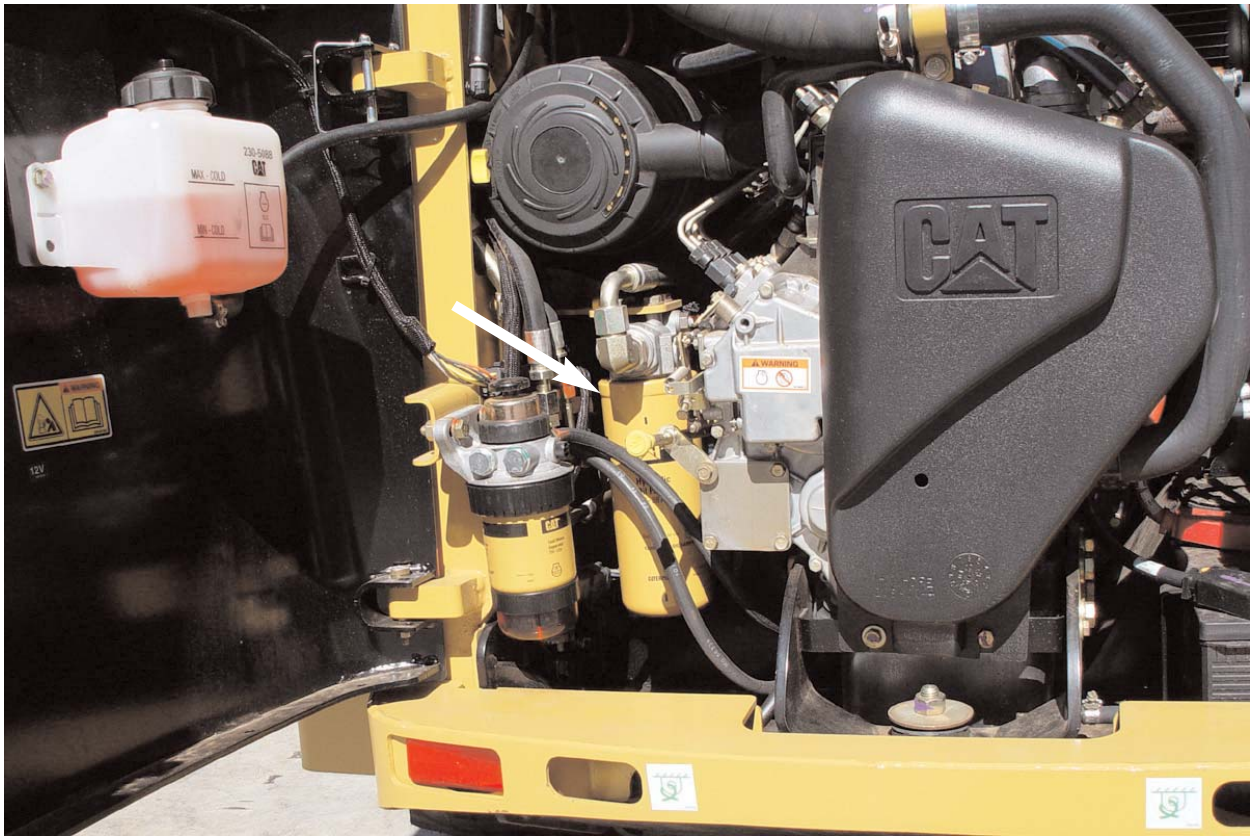
A baffle (6) formed into the hydraulic tank is used to eliminate air bubbles and contamination from entering the suction side of the tank.



40

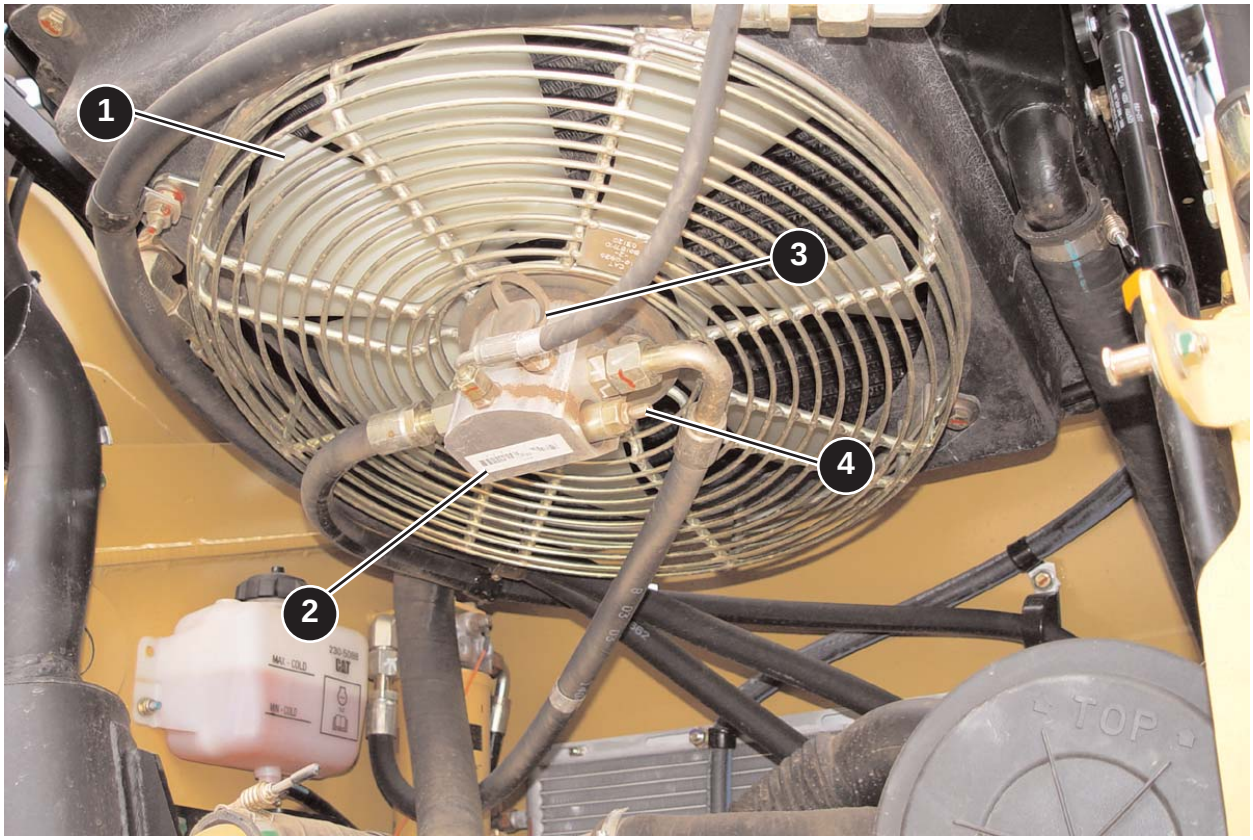
The hydraulic oil filter (2) is located in the rear compartment on the left front side on machines equipped with the 3044C DIT Engine. The hydraulic oil filter base (1) contains a filter bypass valve and switch. If the filter is plugged, the bypass valve opens and the switch closes to turn on the hydraulic oil filter indicator lamp in the operator's compartment. The indicator lamp stays on as long as the valve is open.

With cold oil, the bypass valve opens and the indicator lamp lights temporarily. The lamp goes out when the oil reaches a specified pressure.



41

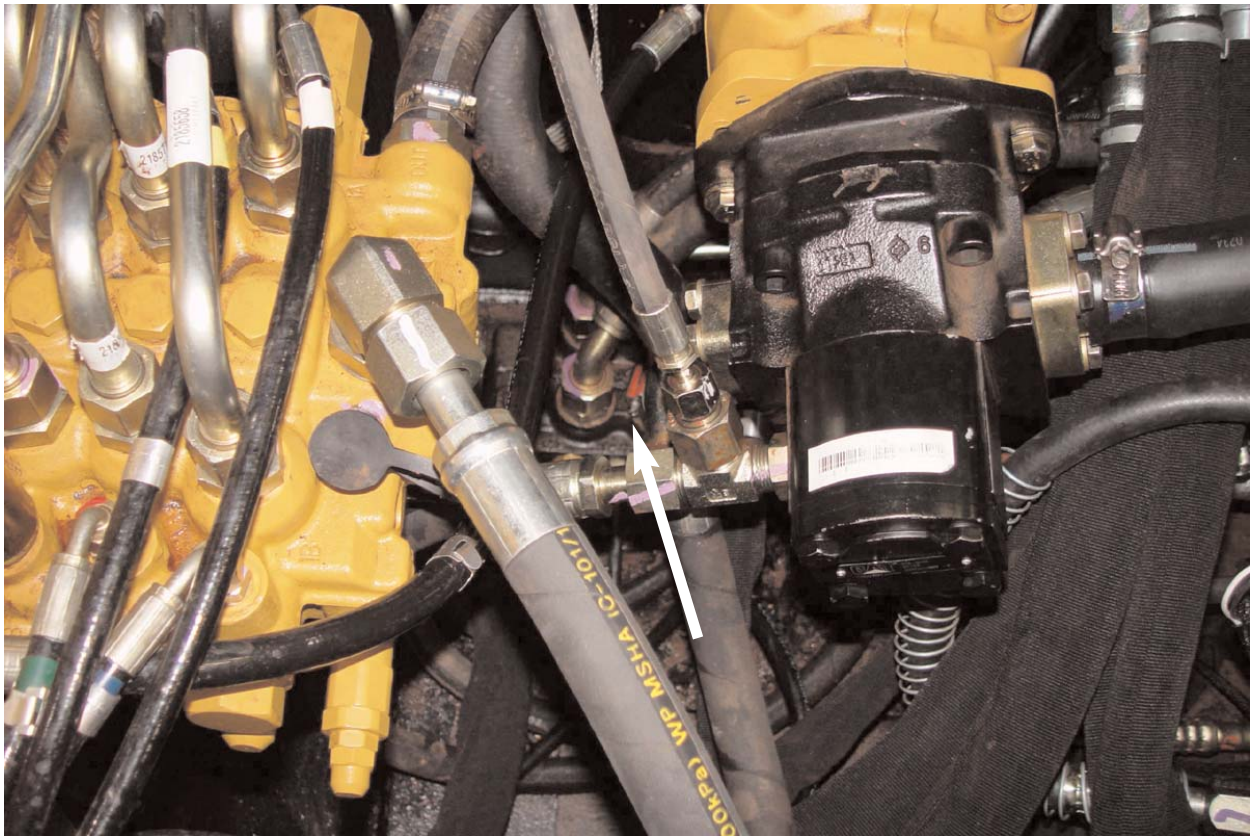
Machines equipped with the 3024C Engine use the same hydraulic filter (arrow) as the larger machines; however, the filter location is different. This illustration shows the hydraulic filter location for machines equipped with the 3024C Engine.



42

The fan (1) and fan motor (2) are located in the rear compartment. The fan provides cooling air for the radiator and hydraulic oil cooler. The fan motor receives oil flow from the charge pump to drive the fan. Fan speed is regulated by the amount of oil flow supplied to the fan motor. At high engine speeds the relief valve (4) limits fan speed.

The hydraulic oil sampling port (3) is located on the fan motor.

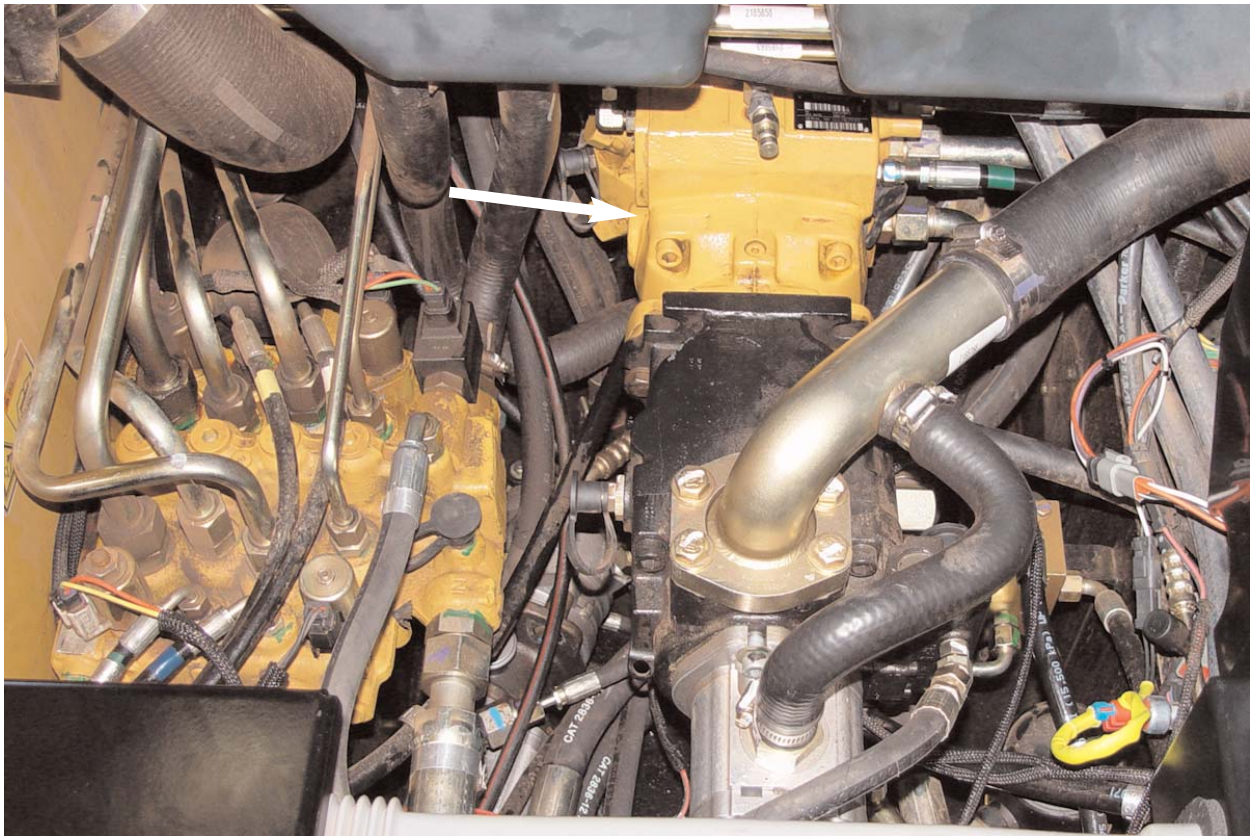


43

The return manifold (arrow) serves as a distribution point for returning oil to the tank from the hydrostatic drive system and the work tool hydraulic system.

The outlet hose to the tank is connected to the top of the return manifold. The return manifold contains a drain valve (not visible) for the machine hydraulic system. A cooler bypass valve is located inside the return manifold.

NOTE: *Some components have been removed in this illustration for photographic purposes.*



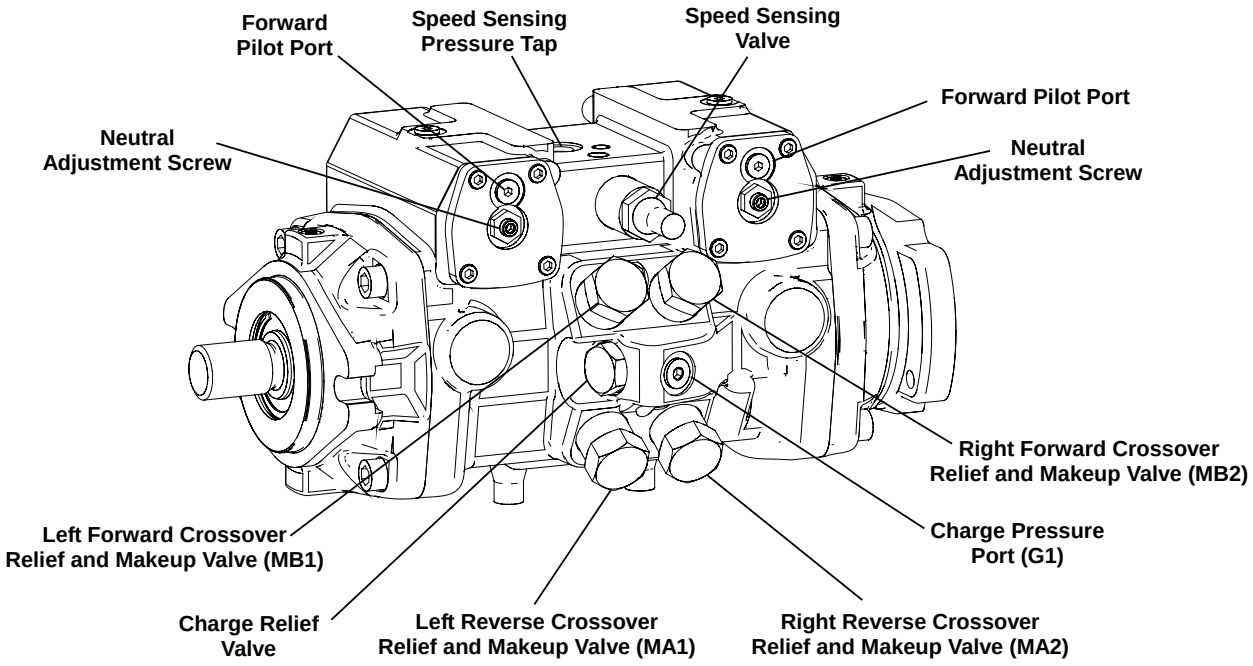
44

This illustration shows the hydrostatic drive pump (arrow) for all machines except the 267B, 277B, and 287B Multi-Terrain Loaders.

The hydrostatic drive pump consists of two rotating groups within a single housing. The pump is connected to the engine flywheel with a splined coupling. The shafts for the pump's rotating groups are connected with a splined coupling. Each swashplate within the rotating group can operate independently.

The hydrostatic drive pump group for the 267B, 277B, and 287B Multi-Terrain Loaders consists of two pumps bolted together. The operation of the pump group for the 267B, 277B, and 287B is the same as the single housing pump.

HYDROSTATIC DRIVE PUMP
COMPONENTS


Forward Pilot Port
Speed Sensing Pressure Tap
Speed Sensing Valve
Forward Pilot Port
Neutral Adjustment Screw
Neutral Adjustment Screw
Right Forward Crossover Relief and Makeup Valve (MB2)
Charge Pressure Port (G1)
Left Forward Crossover Relief and Makeup Valve (MB1)
Charge Relief Valve
Left Reverse Crossover Relief and Makeup Valve (MA1)
Right Reverse Crossover Relief and Makeup Valve (MA2)

45

This illustration shows the components on the right side of the hydrostatic drive pump group.

The charge relief valve limits the maximum charge pressure. As pressure in the charge circuit increases, the charge relief valve opens to maintain the charge pressure.

Crossover relief and makeup valves protect the left and right drive loops by either maintaining system pressure or reducing pressure spikes in the drive loop system. The makeup valves enable charge oil to fill the low pressure sides of the closed loop circuit.

The speed sensing valve directs a reduced charge pressure signal to the travel pilot valves.

Additional components visible on the right side of the hydrostatic drive pump include:

- speed sensing pressure tap (Y)
- forward pilot ports
- neutral adjustment screws for the actuator pistons
- speed sensing valve
- charge pressure tap port (G1)

NOTE:

MB1 refers to the forward drive loop of the pump for the left side of the machine.

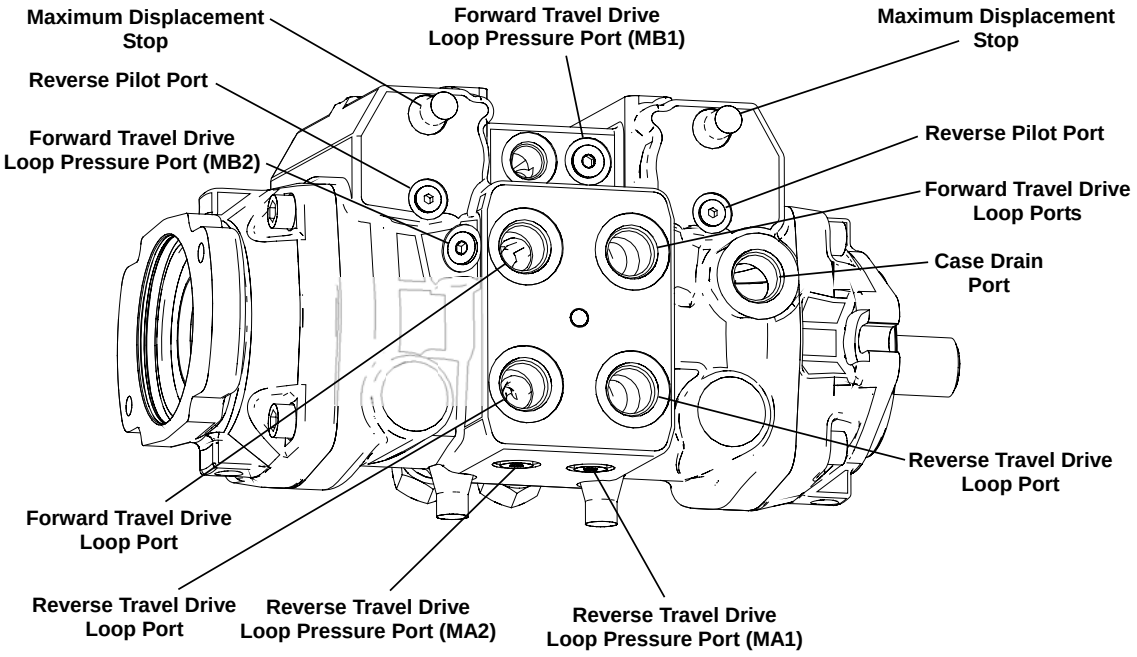
MA1 refers to the reverse drive loop of the pump for the left side of the machine.

MB2 refers to the forward drive loop of the pump for the right side of the machine.

MA2 refers to the reverse drive loop of the pump for the right side of the machine.

Y and G1 are stamped into the housing of the hydrostatic piston pump.

HYDROSTATIC DRIVE PUMP
COMPONENTS


Maximum Displacement Stop
Forward Travel Drive Loop Pressure Port (MB1)
Maximum Displacement Stop
Reverse Pilot Port
Forward Travel Drive Loop Pressure Port (MB2)
Reverse Pilot Port
Forward Travel Drive Loop Ports
Case Drain Port
Reverse Travel Drive Loop Port
Forward Travel Drive Loop Port
Reverse Travel Drive Loop Port
Reverse Travel Drive Loop Pressure Port (MA2)
Reverse Travel Drive Loop Pressure Port (MA1)

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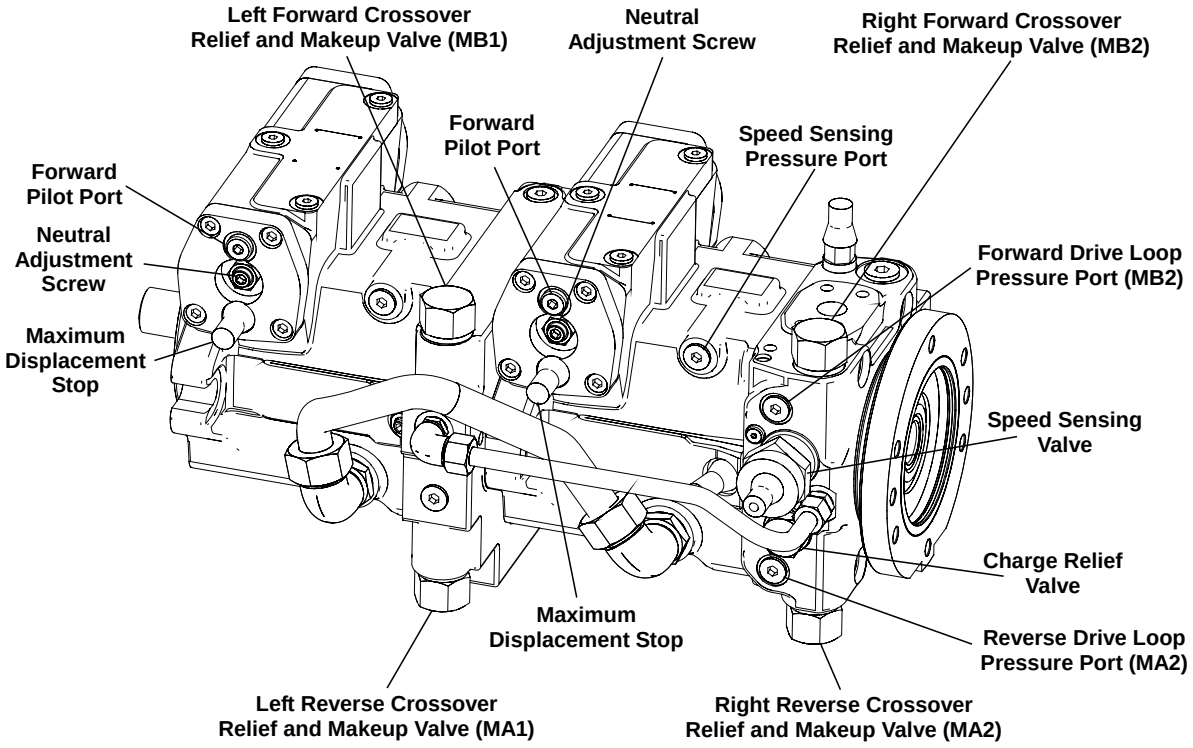
On the left side of the hydrostatic drive pump additional components are visible.

- maximum displacement stops
- pilot ports (reverse)
- forward travel drive loop pressure port (MB2)
- forward travel drive loop pressure port (MB1)
- forward travel drive loop ports
- reverse travel drive loop ports
- reverse travel drive loop pressure port (MA2)
- charge oil port
- case drain port
- reverse travel drive loop pressure port (MA1)

47

The 267B, 277B, and 287B Multi-Terrain Loaders have a different hydrostatic drive pump. The hydrostatic drive pump (arrow) consists of two tandem mounted variable displacement piston pumps that provide oil to the hydrostatic drive motors. The tandem pumps function similarly to the two rotating groups used on the skid steer loaders and remaining multi-terrain loaders.

267B / 277B / 287B HYDROSTATIC DRIVE PUMP
COMPONENTS


Left Forward Crossover Relief and Makeup Valve (MB1)
Neutral Adjustment Screw
Right Forward Crossover Relief and Makeup Valve (MB2)
Forward Pilot Port
Speed Sensing Pressure Port
Forward Pilot Port
Neutral Adjustment Screw
Forward Drive Loop Pressure Port (MB2)
Maximum Displacement Stop
Speed Sensing Valve
Charge Relief Valve
Maximum Displacement Stop
Reverse Drive Loop Pressure Port (MA2)
Left Reverse Crossover Relief and Makeup Valve (MA1)
Right Reverse Crossover Relief and Makeup Valve (MA2)

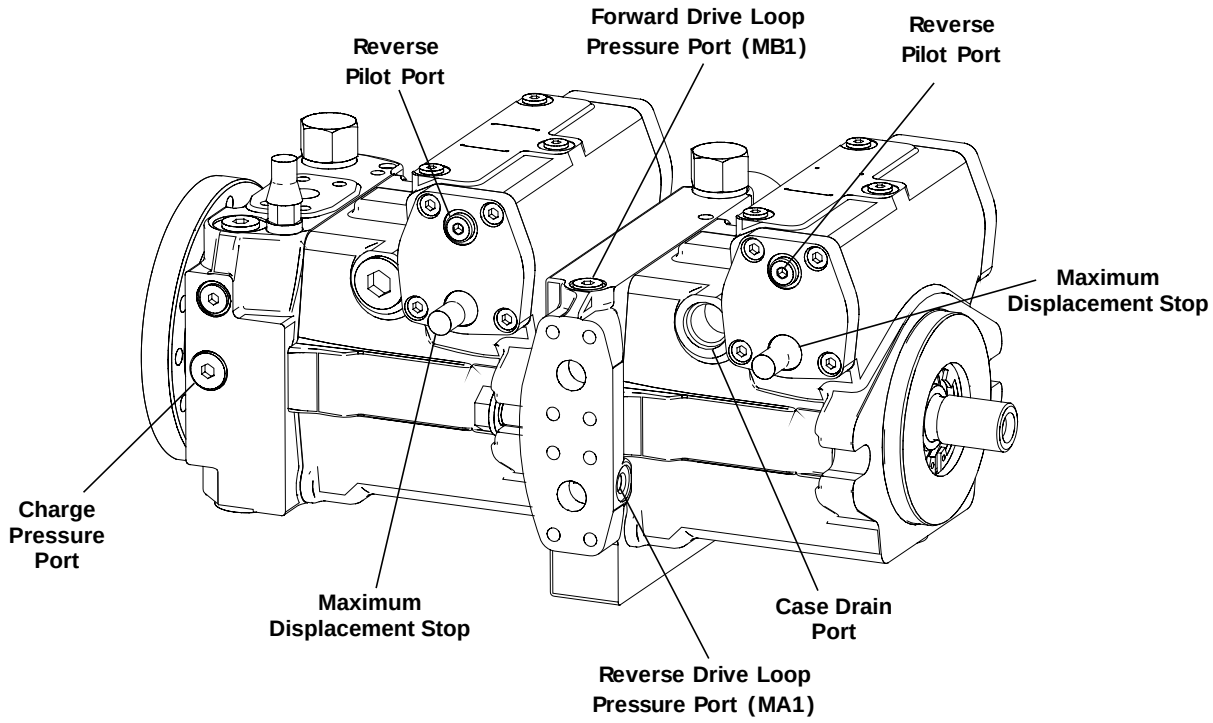
48

The components visible on the left side of the 267B, 277B, and 287B hydrostatic drive pump include:

- speed sensing pressure port
- charge relief valve
- forward pilot ports
- neutral adjustment screws for the actuator pistons
- speed sensing valve
- maximum displacement stops
- forward travel drive loop pressure port (MB2)
- reverse travel drive loop pressure port (MA2)
- left reverse crossover relief and makeup valve (MA1)
- left forward crossover relief and makeup valve (MB1)
- right reverse crossover relief and makeup valve (MA2)
- right forward crossover relief and makeup valve (MB2)

267B / 277B / 287B HYDROSTATIC DRIVE PUMP

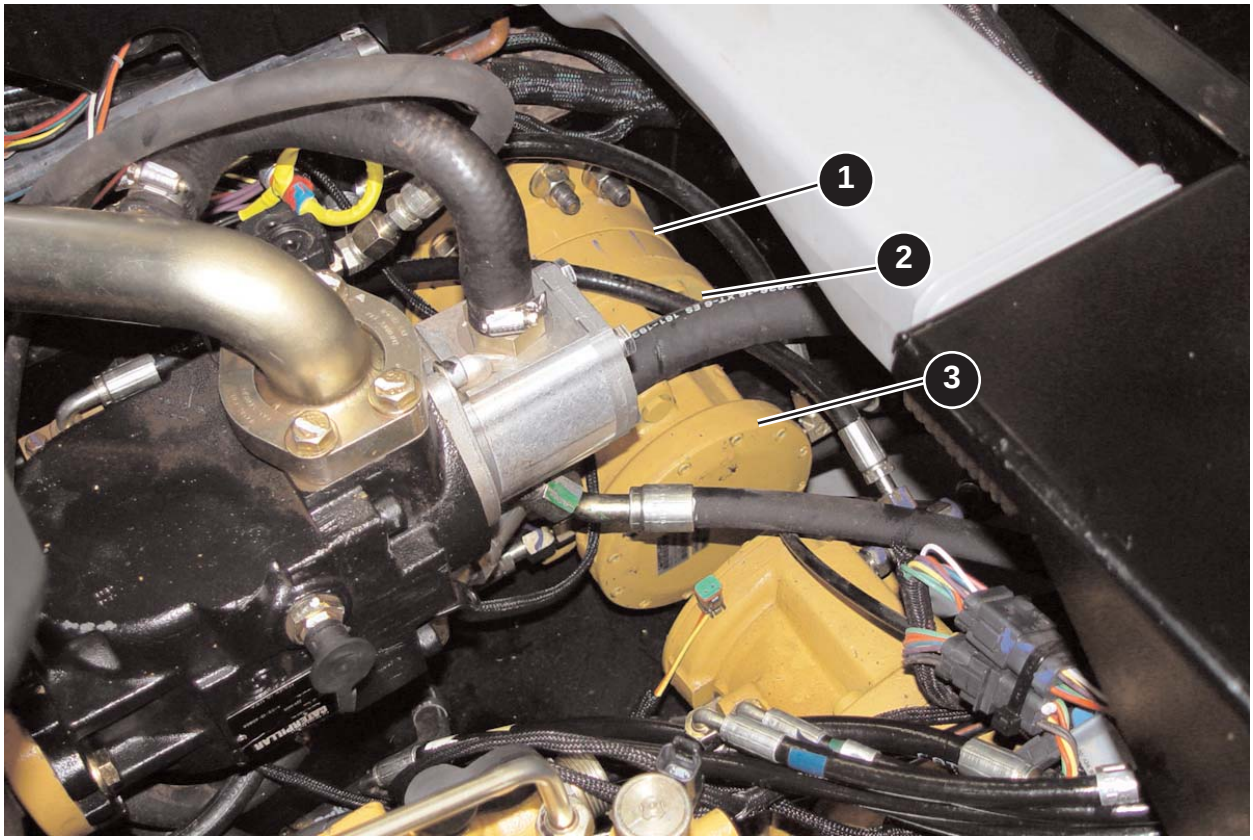
COMPONENTS



49

The components visible on the left side of the 267B, 277B, and 287B hydrostatic drive pump include:

- speed sensing pressure port
- reverse pilot ports
- charge pressure port
- case drain port
- reverse drive loop pressure port (MA1)
- forward drive loop pressure port (MB1)



50

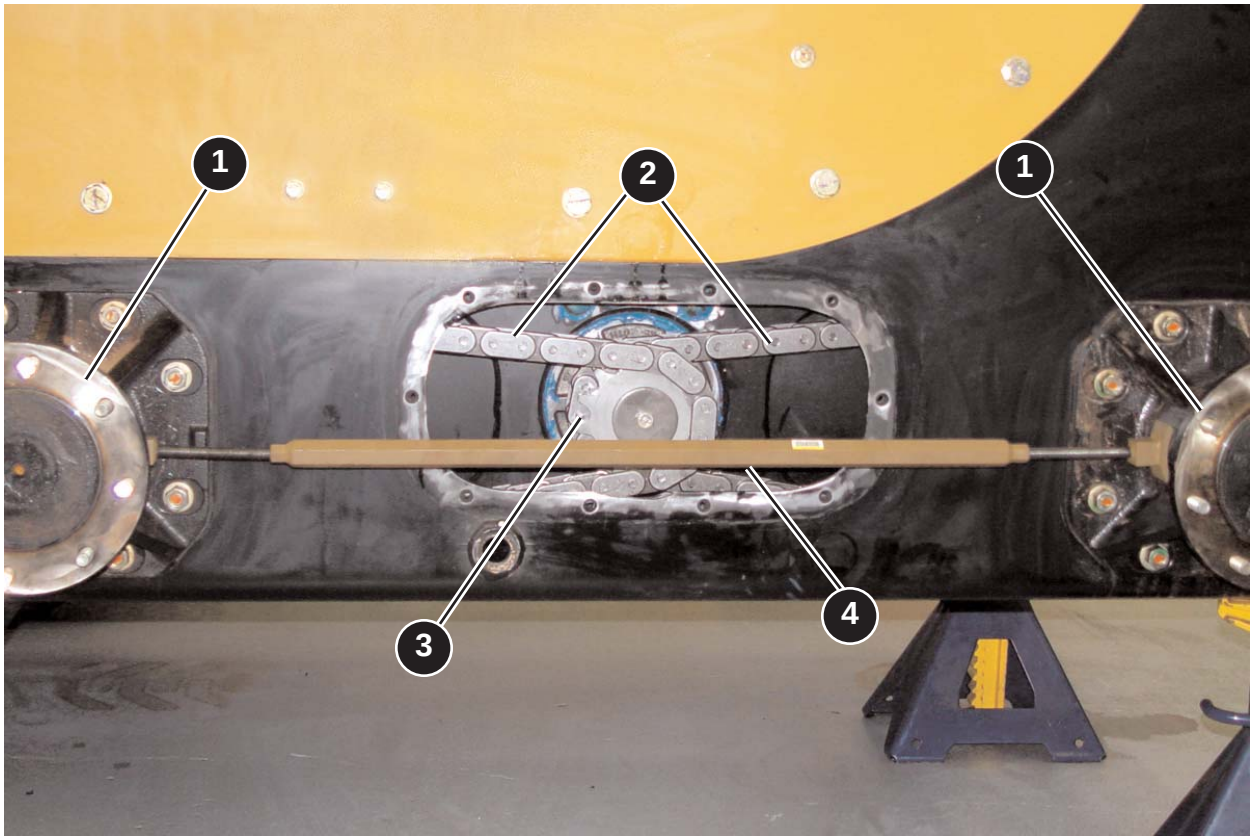
The skid steer loaders hydrostatic drive motors are located below the pumps. The drive motors are radial piston motors consisting of three sections.

The shaft housing (1) supports the drive motor shaft.

The rotor housing (2) contains the rotor and piston assembly.

The brake housing (3) contains the brake clutch pack and brake spring. The brakes are spring engaged and hydraulically released.

Each hydrostatic drive motor contains a flushing valve. The flushing valve maintains a minimum system pressure as it drains some oil from the low pressure side of the drive loop. As the oil flows to the case drain, heat and any contamination is purged from the drive loop.



51

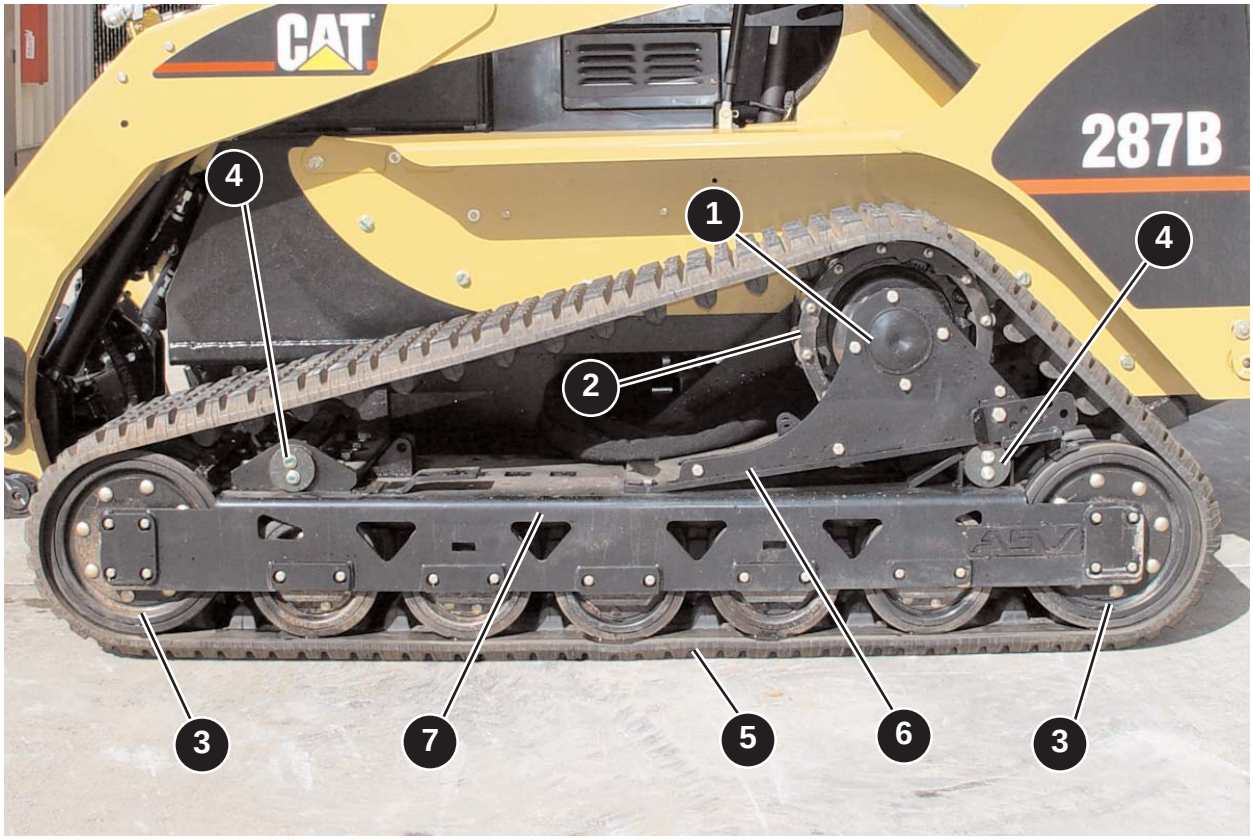
On the skid steer loaders, the tandem drive transfers power from the hydrostatic drive motors to the wheel spindles (1) through the chain reduction drives.

Power is transferred to the drive chains (2) from the motors by single piece, double drive sprockets (3). The inboard chains drive a single sprocket at the front axles and the outboard chains drive a single sprocket at the rear axles.

The sprockets gear reduction ratio is 3:1, which decreases speed and increases torque at the wheel spindles. The drive chains are lubricated in an oil bath at the bottom of the axle sprockets as the chains rotate.

A Chain Adjuster Tool 159-3337 (4) is used to adjust the drive chain tension.

NOTE: *For more information on drive chain adjustment, refer to the machine's Operation and Maintenance Manual.*



52

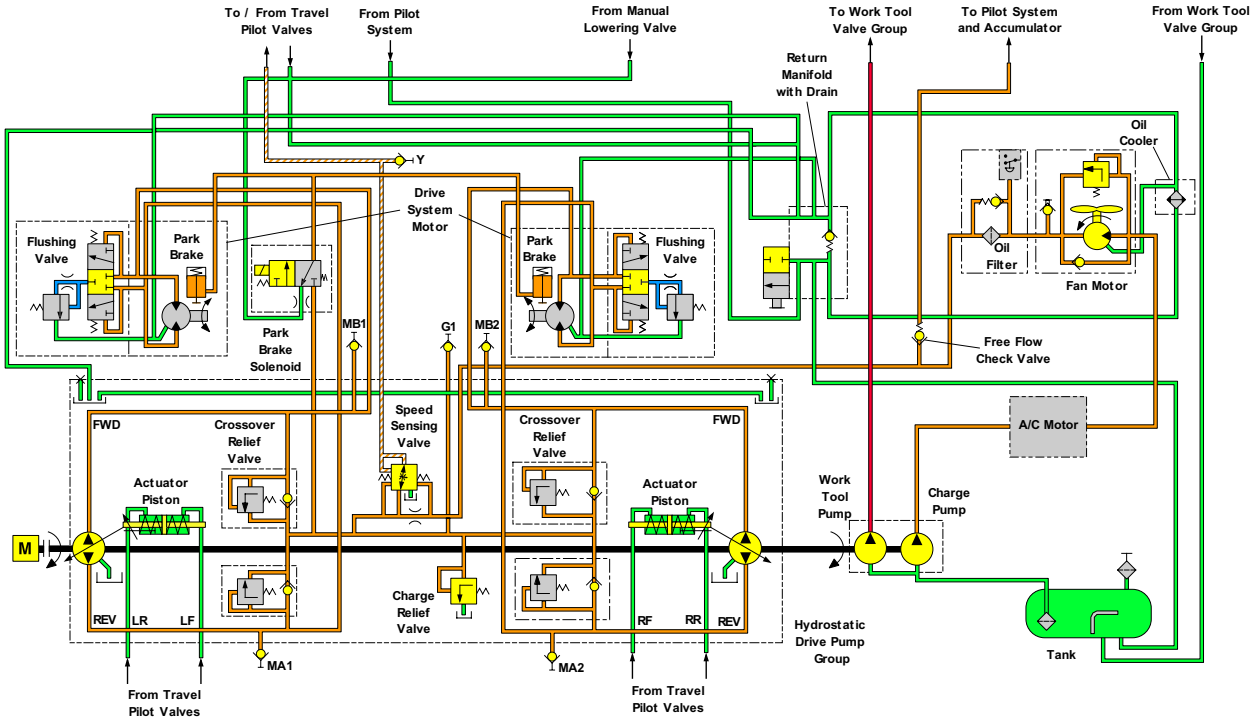
Three types of undercarriages are used on the multi-terrain loaders. This illustration shows the 287B undercarriage, which is mounted to the lower frame of the machine through a set of flexible torsion axles (4). The flexible torsion axles permit each undercarriage assembly to flex independently of each other for smoother travel. The 247B and 257B Multi-Terrain loader use a similar undercarriage. The 267B and 277B undercarriages use articulating wheel carriages in addition to the torsion axles.

Each undercarriage assembly consists of a hydrostatic piston motor (1) which has the drive sprocket group (2) attached to it. The front and rear flexible torsion axles (4) support the undercarriage assembly.

The front and rear idler wheels (3), the tensioner assembly (6), and the carriage assembly (7) enable the undercarriage assembly to flex as the machine moves over rough terrain. As the hydrostatic piston motor rotates, the drive sprocket group (1) rotates engaging the double row of lugs on the track (5).

NOTE: *For track tensioning procedures, consult the machine's Operation and Maintenance Manual.*

MULTI-TERRAIN LOADERS
HYDROSTATIC DRIVE SYSTEM
NEUTRAL / PARK BRAKE SOLENOID ENERGIZED



53

Hydrostatic Drive System Operation

On the multi-terrain loaders, the charge pump sends oil through the A/C motor, fan motor, oil filter, and a free flow check valve. Charge oil flows through a single one-way free flow check valve to the work tool pilot system and accumulator. Charge oil also flows to the speed sensing valve, the charge pump relief valve, the crossover relief and makeup valves, and the park brake valve.

The speed sensing valve sends a reduced charge pressure signal to the travel solenoid (not shown). The travel solenoid directs the reduced charge pressure signal to the travel pilot valves.

The travel pilot valves function as variable pressure reducing valves when shifted. When actuated, the travel pilot valves direct pilot oil to the actuator pistons in the hydrostatic drive pump group.

The actuator pistons control the swashplates. The angle of the swashplates control the amount of oil and the direction of flow from the pump to the motors.

In NEUTRAL, the speed and direction control lever is centered. No signal pressure oil is directed to the actuator pistons and the pilot valves. The signal lines from the pilot valves are open to drain. With no signal pressure oil to either end of the actuator pistons, the pistons stay in the centered or neutral position.

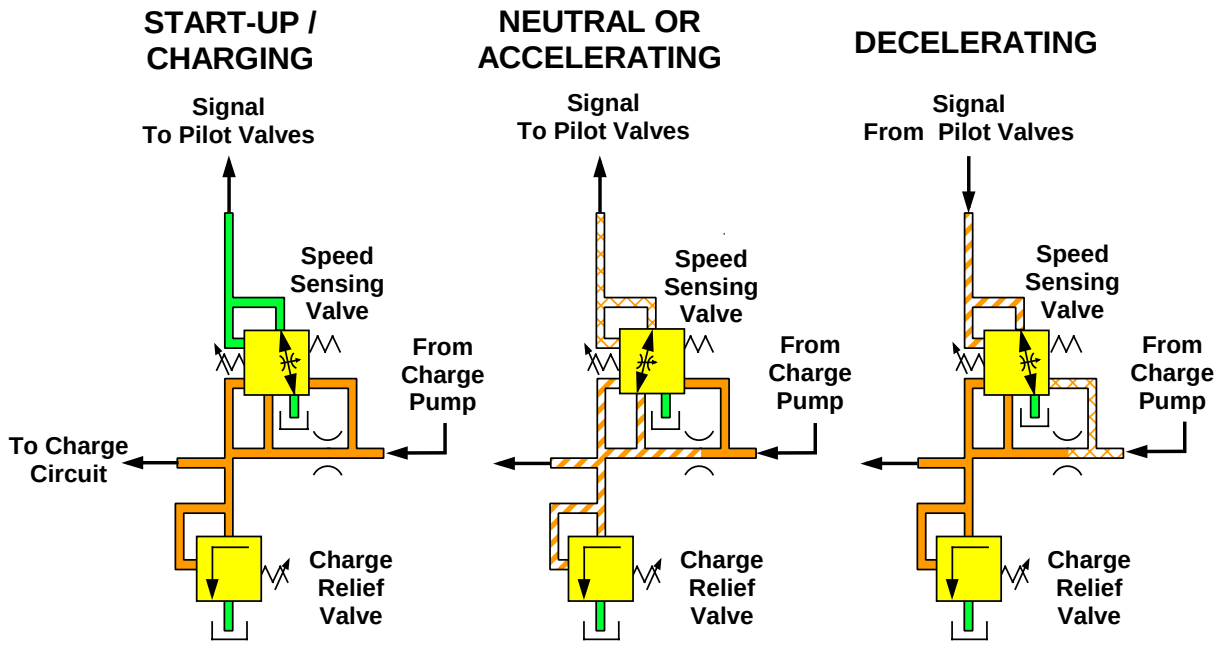
The centering springs for the actuator pistons hold the swashplates at zero angle. With the swashplates in this position, the hydrostatic drive pump group does not produce oil flow. Without output from the hydrostatic drive pump group to turn the drive motors, the machine does not move.

The crossover relief and makeup valves protect the system by either maintaining a minimum drive loop pressure or reducing pressure spikes in the drive loops. At machine start-up, the makeup valves open to direct charge oil to both sides of the pump and motor. The oil in both lines to the drive motors are approximately at charge pressure.

When the engine is started, the park brake solenoid is de-energized. The park brake solenoid directs oil to drain and the park brakes are engaged by spring force. When the operator depresses the park brake switch, a signal is sent to the Operator Interlock ECM. The Operator Interlock ECM energizes the park brake solenoid. The park brake solenoid valve directs oil to the park brake piston, which acts against the spring force to release the brakes.

The main purpose of the flushing valve is to drain some oil from the low pressure side of the drive loop to case drain, which purges heat and any contamination from the drive loop. The relief valve in the flushing valve also controls the minimum pressure in the low pressure side drive loop when the machine moves.

SPEED SENSING VALVE



54

The speed sensing valve regulates the signal pressure oil (based on engine speed) to the travel pilot valves. The speed sensing valve is shown in three different states.

When the machine is started, the speed sensing valve is in the START-UP or CHARGING position. The charge pump provides oil flow to the speed sensing valve. Initially, no signal oil (drive signal) is sent to the travel pilot valves. From the speed sensing valve, charge oil flows through the crossover relief and makeup valves to charge the closed loop drive system.

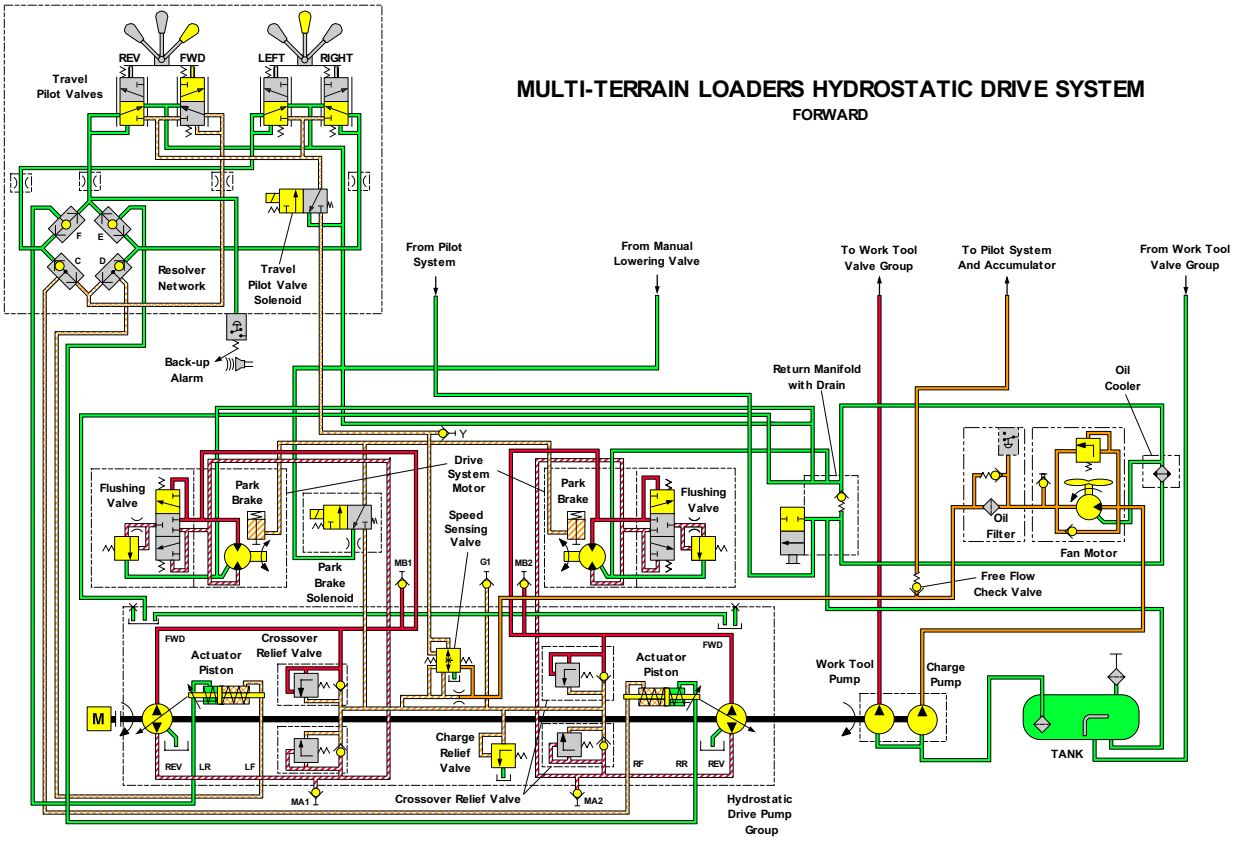
After the drive loop is charged, the higher charge pump oil pressure on the right side of the speed sensing valve, with assistance from the spring, causes the speed sensing valve to shift to the NEUTRAL position allowing signal oil to flow to the travel pilot valves.

When a travel mode is selected and the engine speed is increased, the speed sensing valve increases the signal to the hydrostatic travel pilot valves. This action results in higher speed once the travel pilot valves are shifted.

When the machine decelerates, the charge pump sends less flow to the speed sensing valve. The charge oil pressure is now lower on the right side of the speed sensing valve than on the left side causing the speed sensing valve to shift to the right, directing the signal oil to the tank. With a reduced signal at the travel pilot valves, the hydrostatic pump group begins to destroke. This action prevents engine lug.

The charge relief valve limits the maximum charge pressure. As pressure in the charge circuit increases, the charge relief valve opens to maintain the charge pressure.

NOTE: *The three positions of the speed sensing valve shown here are to improve comprehension of the operation of the valve. The single position envelope shown on the system schematics represents all three of these positions.*



55

This illustration shows the conditions that are present when the speed and direction lever is moved to the forward position.

As the speed and direction lever is moved forward, signal pressure from the forward pilot valve is directed to left forward (C) and right forward (D) resolvers.

When the travel pilot valve is shifted, it functions as a variable pressure reducing valve which directs signal oil to a resolver. A resolver is a double check valve which compares two pressure signals and sends the highest resolved pressure to the actuator pistons. In NEUTRAL, both sides of the resolvers are open to the drain.

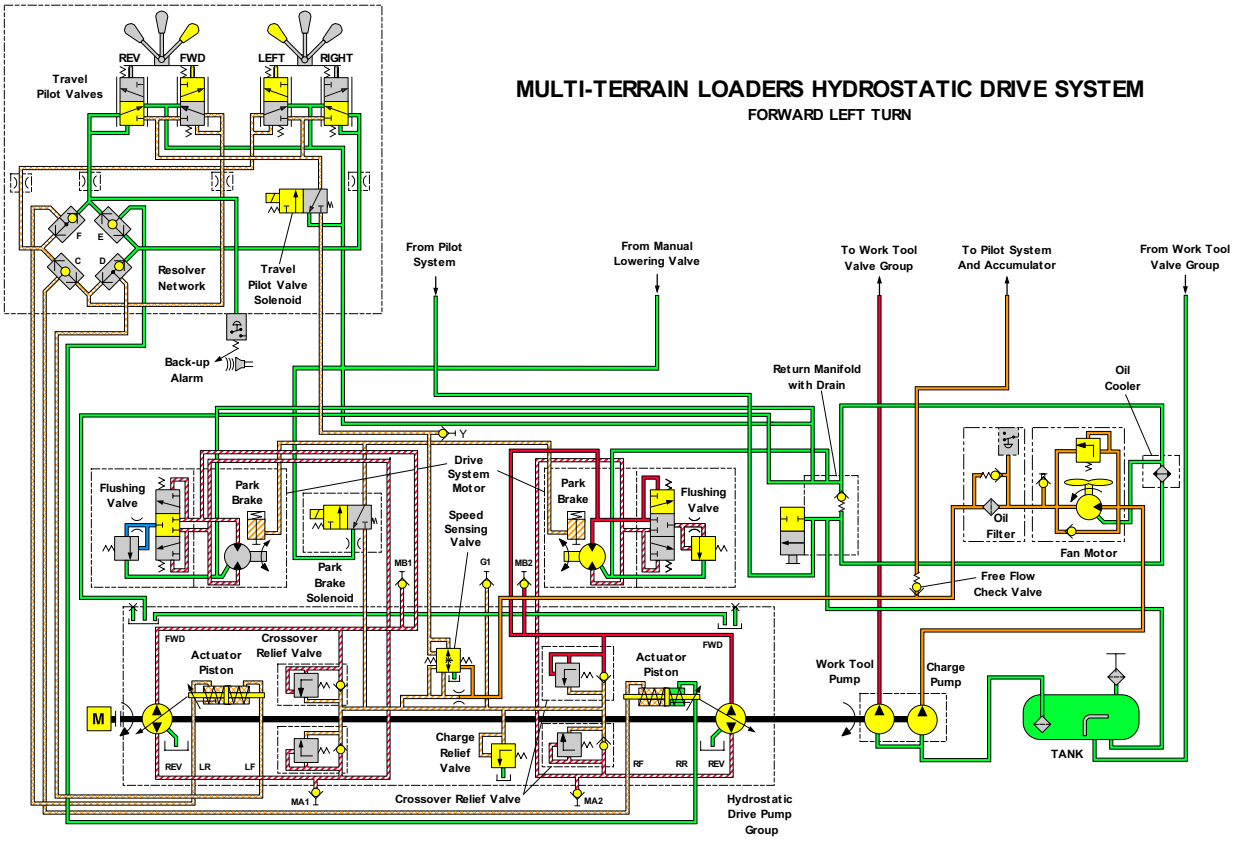
The resolver compares the pressure between the two pilot valve spool signals when forward or reverse travel is initiated concurrently for a right or left turn. The highest pressure unseats the ball and signal oil flows to the the actuator pistons.

For FORWARD, the oil pressure unseats the resolver balls and signal oil flows to the right end of both actuator pistons. The pressure of the signal oil determines how far the actuator pistons move.

The signal pressure oil at the actuator pistons moves the swashplates to the forward position.

As the swashplates move, pump output flow increases and is sent to the drive motors. The oil from the pump also flows to the top of the flushing valve and moves it down. With the flushing valve moved, oil from the low pressure side of the drive motors flows across it and through the relief valve back to the return manifold.

With no restrictions in the drive motor loop, the flows causes the drive motors to rotate, and the machine moves FORWARD.



56

This illustration shows the conditions that are present when the speed and direction lever is moved for a FORWARD LEFT TURN.

As the speed and direction lever is moved forward and to the left, signal pressure from the forward pilot valve is directed to the left forward (C) and right forward (D) resolver balls. Signal pressure from the left turn port of the pilot valve is directed to the left forward (C) resolver ball and to the left reverse (F) resolver ball.

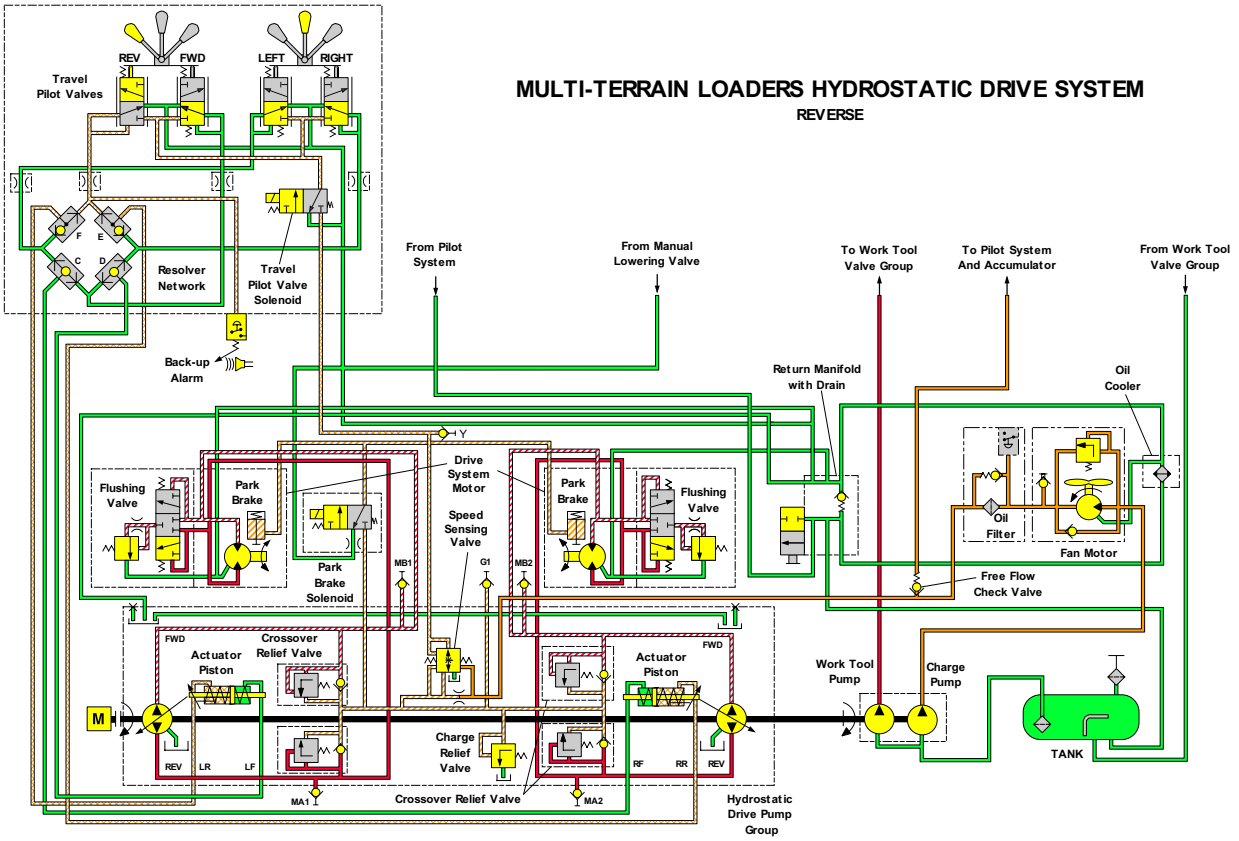
The oil pressure unseats the resolver balls. Signal oil flows to both ends of the left actuator piston keeping it in a neutral position and signal oil flows to the right end of the right actuator piston.

With signal oil pressure present on both sides of the left actuator piston, the movement of the piston is minimal, therefore the left swashplate also has minimal movement producing a reduced pump flow to the left drive motor.

With minimum output from the left rotating pump, the oil flow through the output port to the left drive motor will be reduced.

The signal oil at the right actuator piston moves the swashplate to the forward position. As the swashplate moves, pump output flow increases and is sent to the right drive motor causing the right drive motor to rotate. The right drive motor turns the right drive wheel FORWARD.

The left drive motor turns at a slower speed than the right drive motor resulting in a FORWARD LEFT TURN.



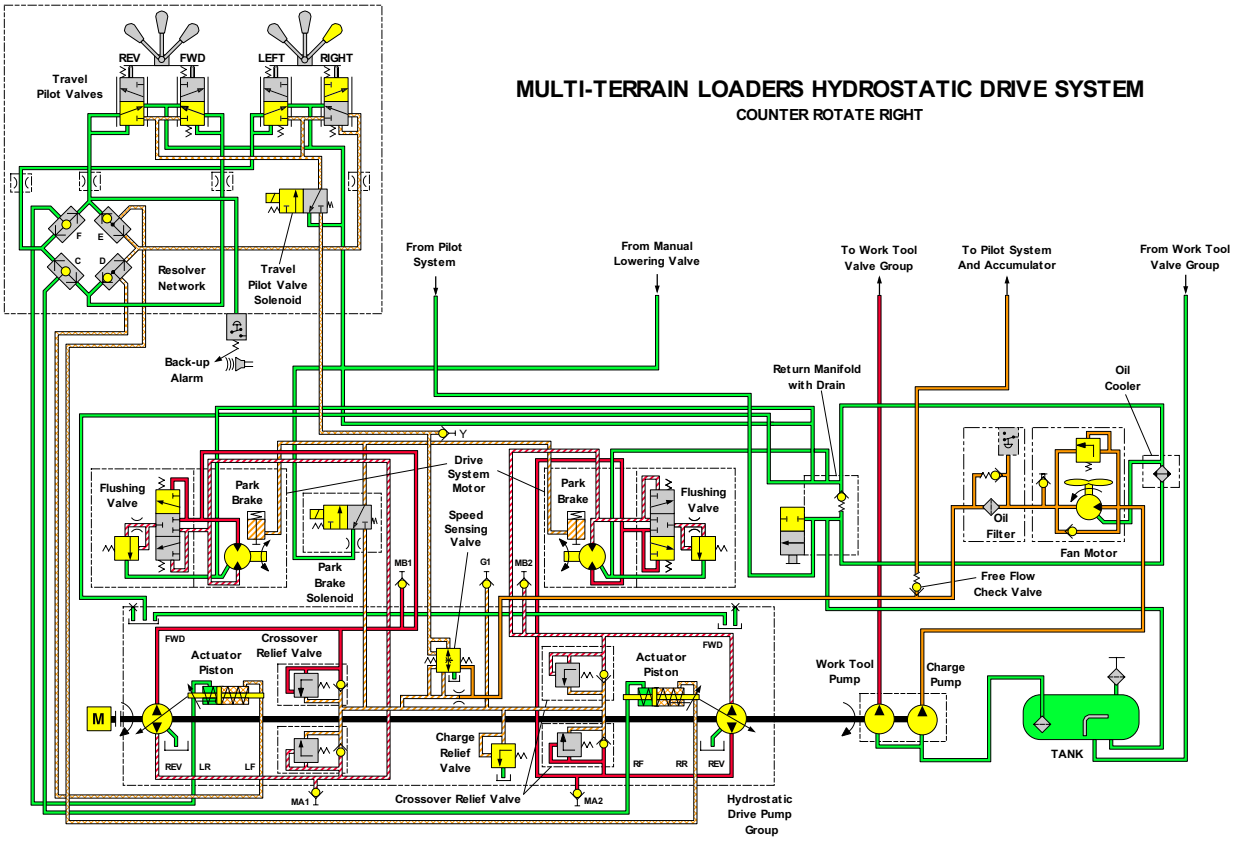
57

This illustration shows the conditions that are present when the speed and direction lever is moved to the REVERSE position.

As the speed and direction lever is moved rearward, signal pressure from the reverse pilot valve is directed to the reverse resolvers (F) (E).

The oil pressure unseats the resolver balls and signal oil flows to the right end of both actuator pistons. The pressure of the signal oil determines how far the actuator pistons move.

The signal pressure oil at the actuator pistons moves the swashplates to the reverse position. As the swashplates move, pump output flow increases and is sent to the drive motors. The machine moves in REVERSE.



58

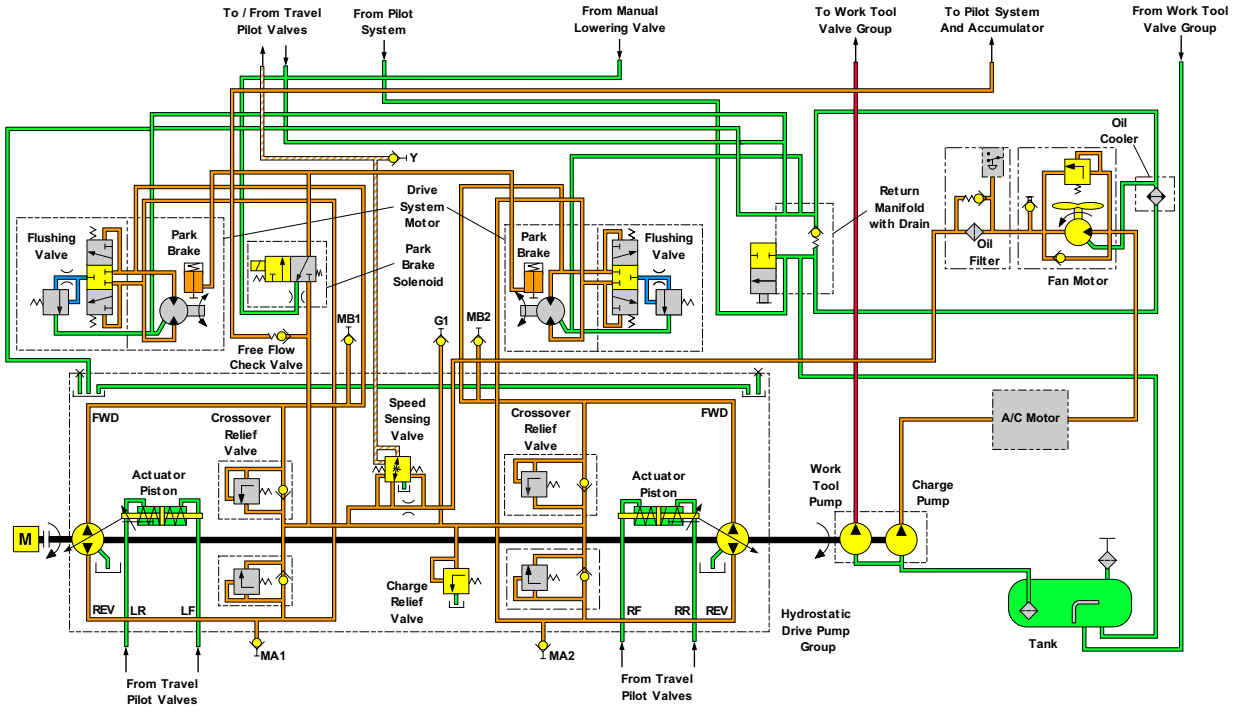
This illustration shows the conditions that are present when the speed and direction lever is moved to the RIGHT position.

As the speed and direction lever is moved to the right, signal pressure from the right pilot valve is directed to the resolver network. The oil pressure unseats the resolver balls and signal oil flows to both actuator pistons.

The signal pressure enters at the right end of the left actuator piston and the left end of the right actuator piston. The pressure of the drive signal oil determines how far the actuator pistons move.

The signal pressure oil at the actuator pistons causes the swashplate angle of each pump to increase. As the swashplates begin to move, pump output flow increases and drives the left motor FORWARD and the right motor in REVERSE. The machine turns to the RIGHT on its axis.

SKID STEER LOADERS
HYDROSTATIC DRIVE SYSTEM
NEUTRAL / PARK BRAKE SOLENOID ENERGIZED



59

The hydrostatic drive system for the skid steer loaders is similar to the multi-terrain loaders that was previously described. The difference is the location of the free flow check valve.

On the skid steer loaders, the charge pump sends oil through the fan motor and oil filter to the speed sensing valve, the charge relief valve, and the crossover relief and makeup valves.

From the hydrostatic drive pump group, charge oil flows to the parking brake solenoid and through the free flow check valve to the pilot system and accumulator.

NOTE: For instruction purposes only, on the schematic, the free flow check valve is located beneath the parking brake solenoid.

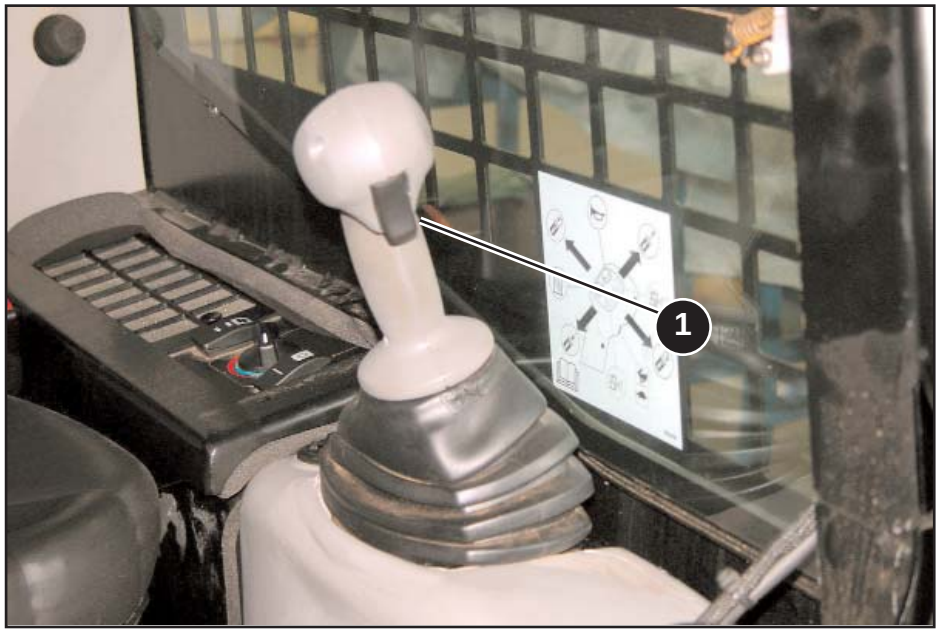
60

Two-Speed Travel Operation

The two-speed travel system improves machine productivity with faster cycle times by providing increased travel speeds. The operator is able to select either Rabbit Mode or Turtle Mode. Turtle Mode provides maximum rimpull and torque, while Rabbit Mode provides increased travel speed and decreased torque. The travel speed is increased by blocking flow to half of the pistons in the travel motor. With the same pump flow working on half of the pistons, the motor spins faster.

The two-speed travel option is available on the 236B, 246B, 248B, 252B, 262B, and the 268B skid-steer loaders. The two-speed travel option is not available on multi-terrain loaders.

A film (arrow) below the model number on the side of the machine indicates that the machine is equipped with two-speed travel.



61

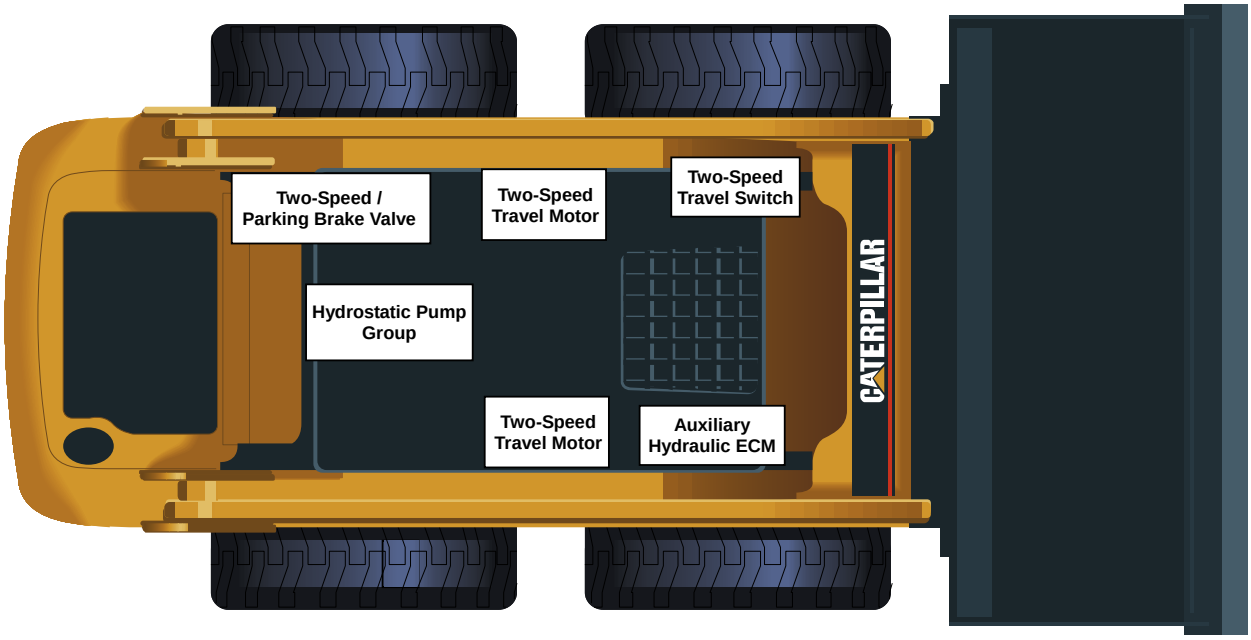
62

The two-speed travel switch (1) is located on the front of the speed and direction lever. The two-speed travel switch is a momentary switch that signals the Auxiliary Hydraulic ECM to switch travel modes. The Auxiliary Hydraulic ECM is located below the operator's compartment.

The two-speed indicator (2) is located on the right console. The two-speed indicator illuminates whenever Rabbit Mode is enabled.

The Auxiliary Hydraulic ECM returns the two-speed mode to Turtle Mode whenever the machine is turned off.

TWO-SPEED TRAVEL SYSTEM
COMPONENTS



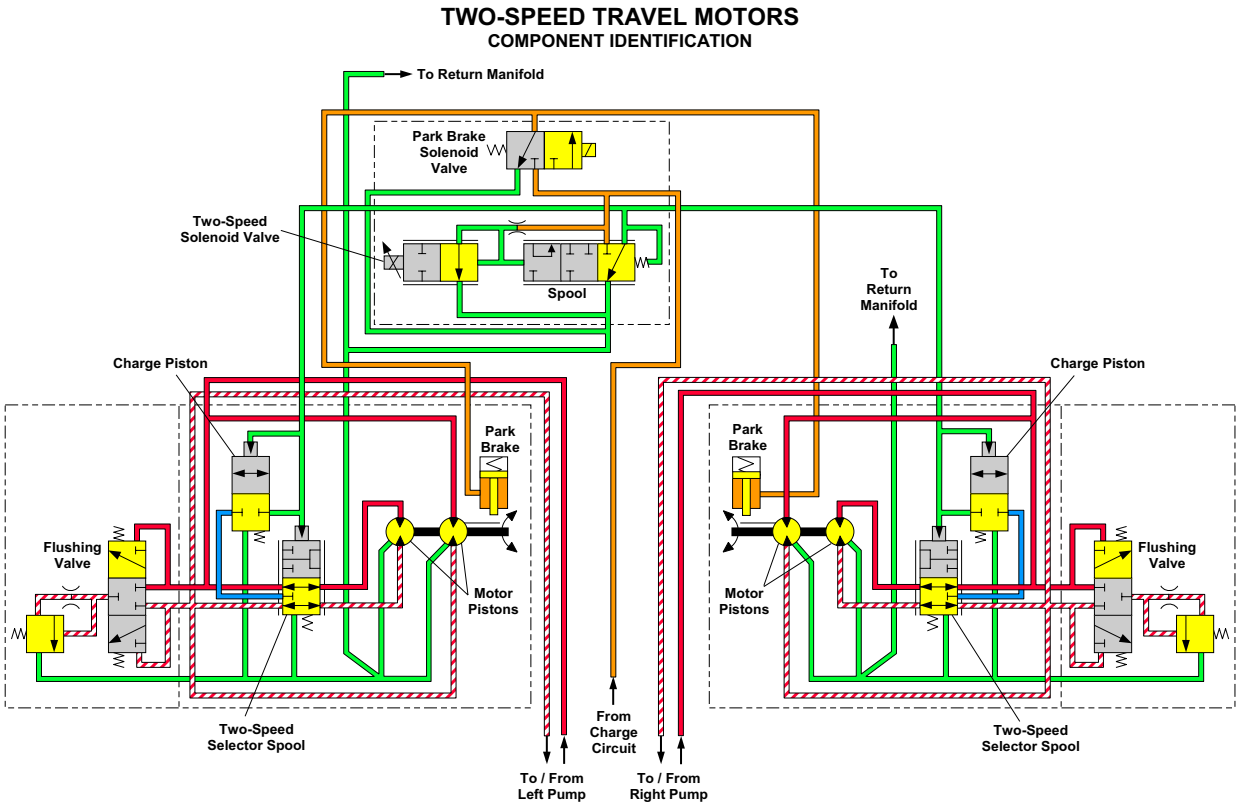
63

The two-speed travel system functions similarly to the standard hydrostatic travel system; however, some additional components are required.

The two-speed travel system uses a smaller displacement hydrostatic pump group than machines equipped with the standard travel system. Different travel motors are used on two-speed machines. The two-speed travel motor contains additional spools and passages which allow the oil supply to half of the motor pistons to be blocked.

The two-speed travel system uses a different parking brake valve. The parking brake valve on two-speed machines includes the two-speed solenoid valve. The two-speed/parking brake valve is located below the operator's compartment on the left side of the machine.

The two-speed travel switch is located on the front of the speed and direction lever. The two-speed travel switch is a momentary trigger switch that signals the Auxiliary Hydraulic ECM to switch travel modes. The Auxiliary Hydraulic ECM is located below the floor plate.

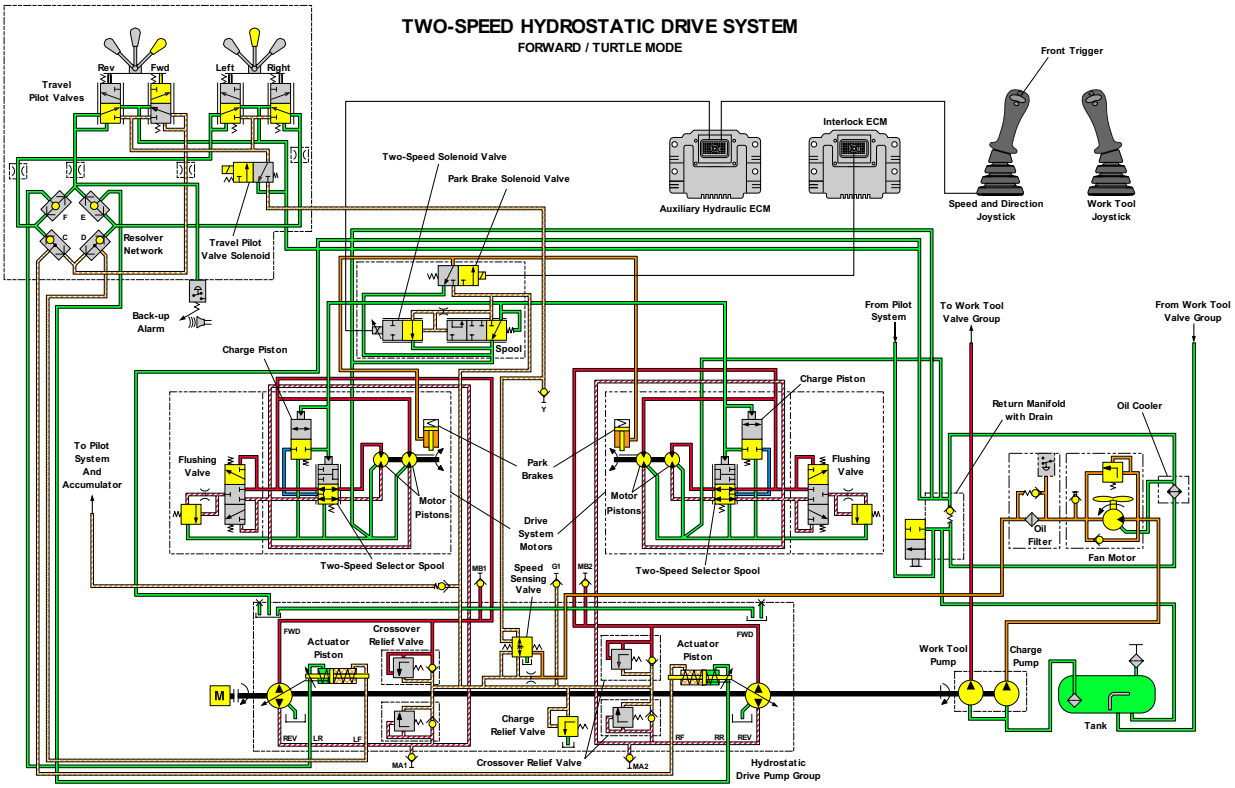


64

This illustration shows a schematic of the two-speed travel motors and the two-speed/parking brake valve. The two-speed/parking brake valve contains two solenoid valves and a control spool. The parking brake solenoid valve functions similarly to the parking brake solenoid valve on machines equipped with the standard hydrostatic system. The two-speed solenoid valve is used to shift the control spool which directs charge oil to the two-speed components in both travel motors.

The travel motor is a radial-piston type motor. Two sets of passages direct flow to and from the hydrostatic pump to the motor pistons. Each set of passages supplies half of the travel motor pistons. In Turtle Mode, oil in one of the passages must flow past the two-speed selector spool before reaching the pistons. In Rabbit Mode, the two-speed selector spool is shifted, blocking the flow. With equal flow from the pump flowing to half of the pistons, the motor speed increases. A charge piston in the motor directs charge oil from the two-speed circuit to the blocked pistons. The charge oil keeps the pistons seated, avoiding wear.

NOTE: *The schematic shows two motor symbols in each motor. Each motor symbol represents half of the pistons in the motor.*

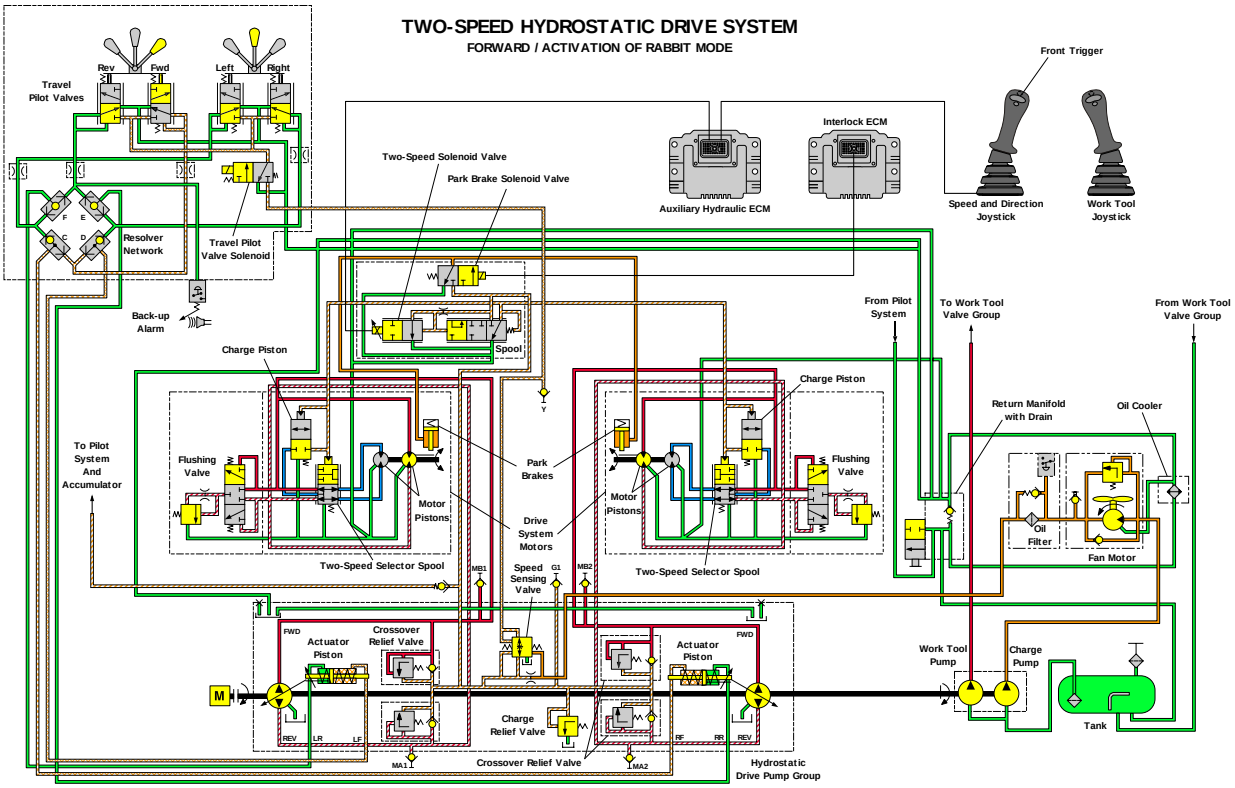


65

This illustration shows the two-speed travel system in Turtle Mode. Pump operation is identical to the standard hydrostatic drive system. The speed sensing valve controls pilot flow to the travel pilot valves. When a pilot valve is shifted, pilot oil is directed to the pump actuator pistons to stroke the pump.

In Turtle Mode, the two-speed solenoid is de-energized and all of the travel motor pistons receive flow from the hydrostatic pump. In Turtle Mode, the two-speed travel motor operates the same as the standard travel motor.

The default state for the two-speed travel system is Turtle Mode. The Auxiliary Hydraulic ECM returns the machine to Turtle Mode whenever the machine is turned off.

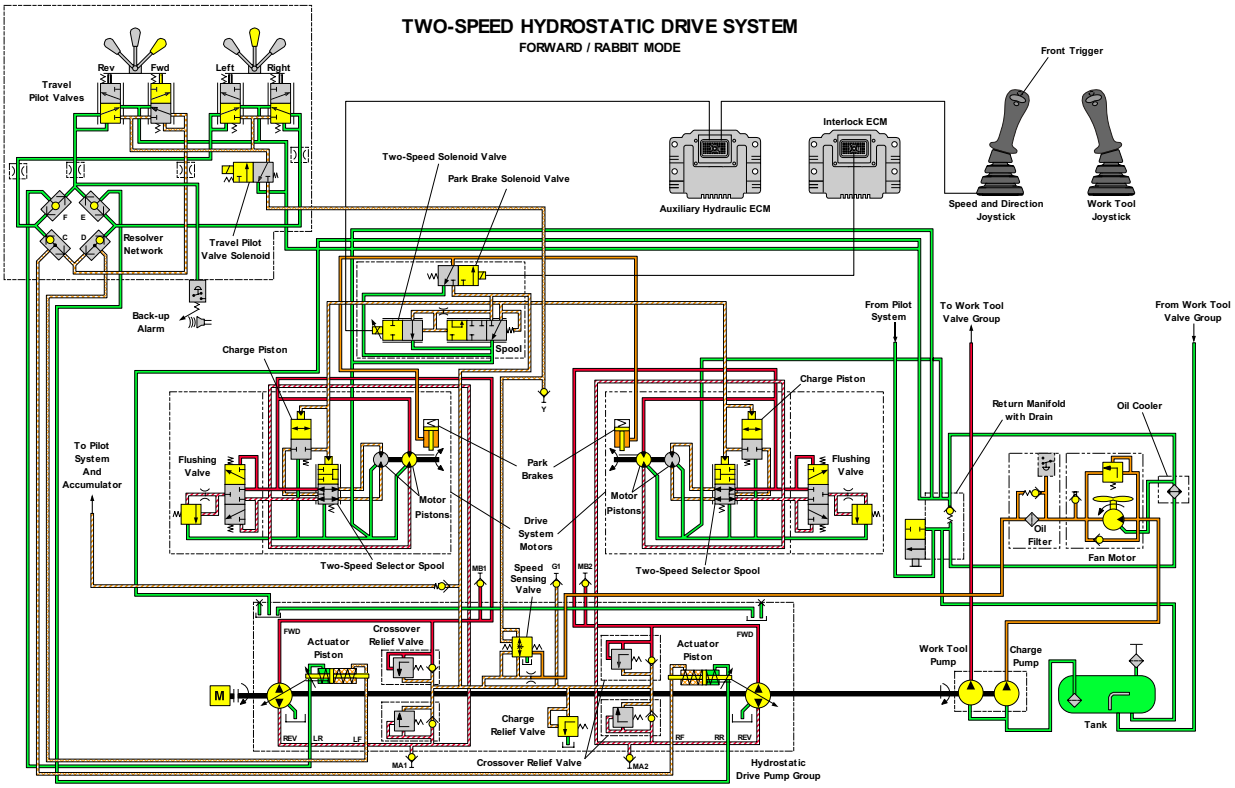


66

To activate Rabbit Mode, the operator presses the momentary switch on the front of the speed and direction lever. The switch signals the Auxiliary Hydraulic ECM which energizes the two-speed solenoid. The two-speed solenoid valve shifts to block charge oil coming from the hydrostatic pump group from draining to the return manifold. The restriction created by the two-speed solenoid causes pressure to build against the orifice, shifting the spool to direct charge oil to each travel motor.

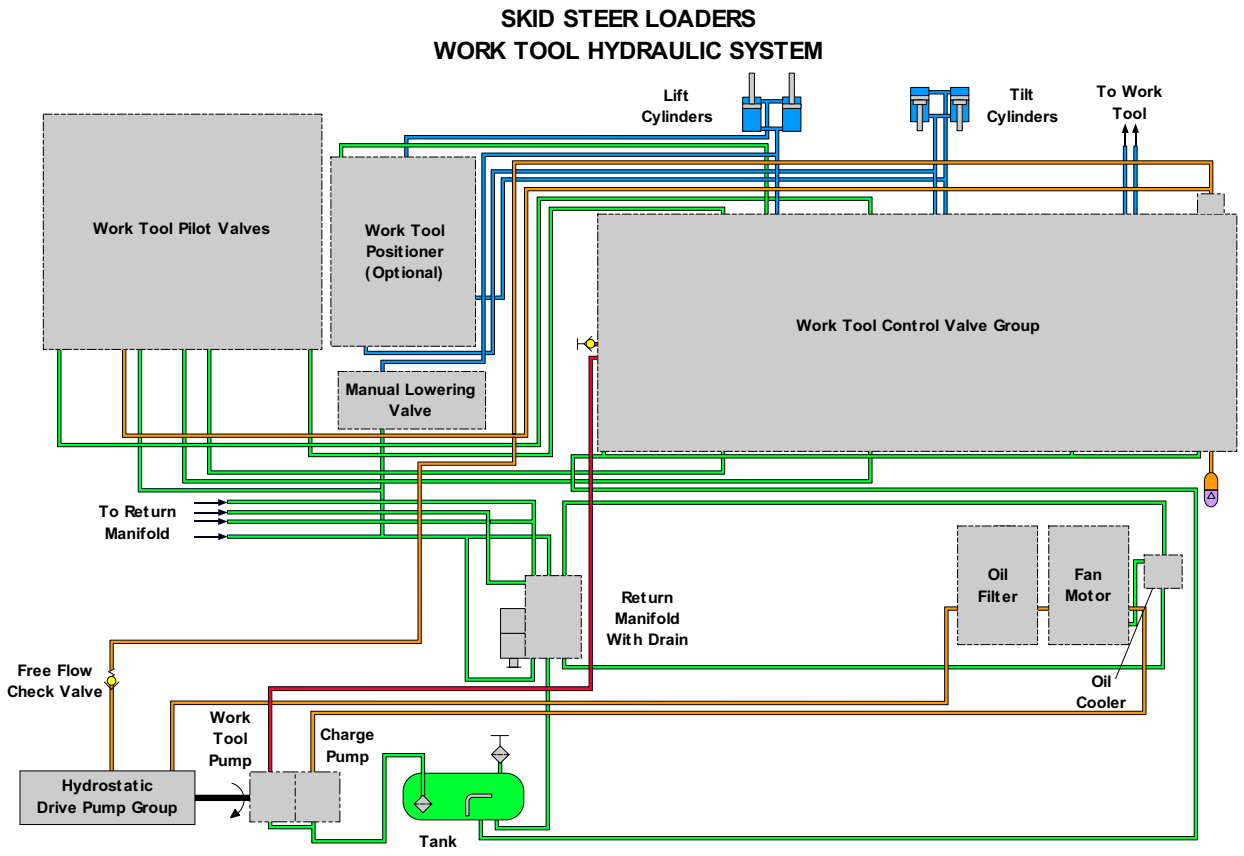
The charge oil enters the travel motor and shifts the two-speed selector spool. The two-speed selector spool blocks flow from the hydrostatic pump to half of the travel motor pistons. The travel motor speed increases due to the decreased displacement of the travel motor.

Charge oil entering the travel motor also works against the charge piston. Because the charge oil pressure at the activation of the Rabbit Mode is less than the force of the spring at the bottom of the charge piston, the charge piston does not shift.



67

The charge piston shifts when the charge oil pressure entering the travel motor is sufficient to overcome the force of the charge piston spring. The shifted charge piston allows charge oil to flow through the two-speed selector spool to both the supply and pressure ports of the blocked travel motor pistons. The charge oil keeps the pistons seated while the travel motor spins at faster speeds.



68

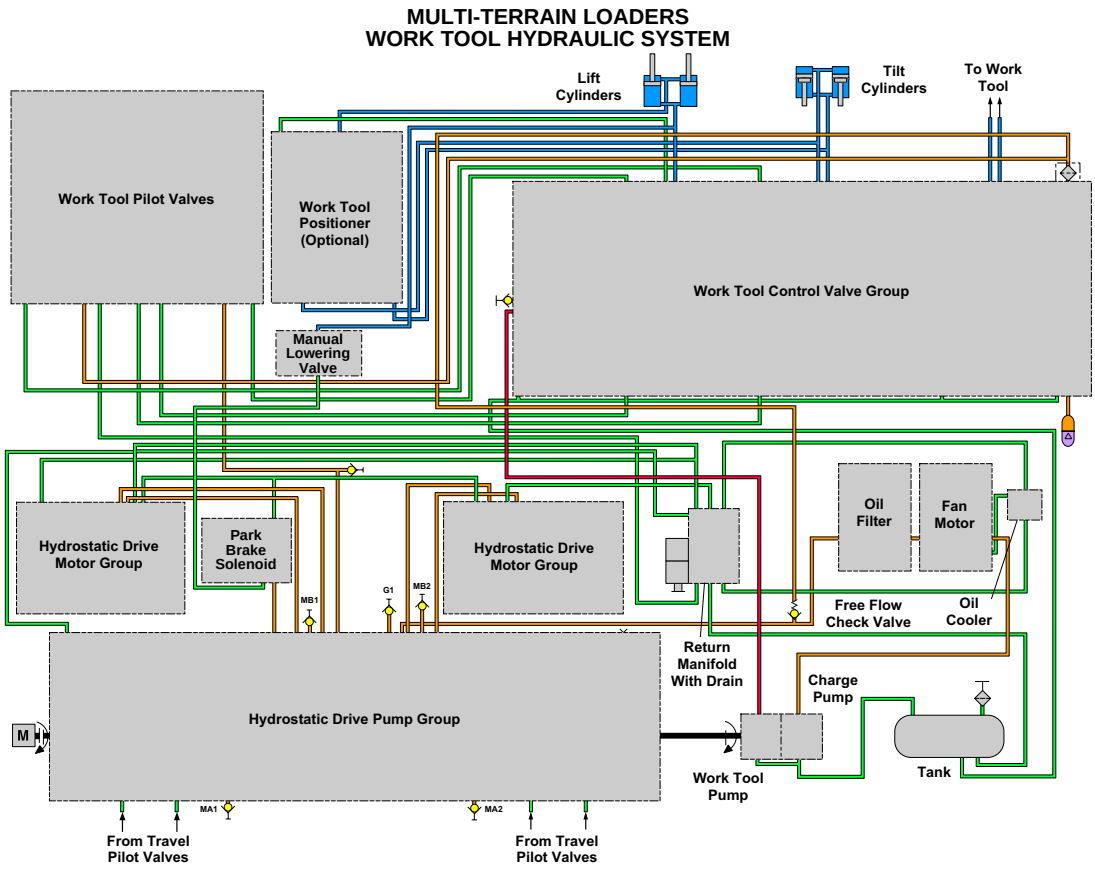
WORK TOOL HYDRAULIC SYSTEM

The skid steer loaders excluding the 248B and the 268B are equipped with an open-center, pilot-operated work tool hydraulic system. The work tool hydraulic system consists of a tank, a fixed displacement pump, a control valve group, two lift cylinders, two tilt cylinders, and an auxiliary work tool. The work tool control valves are in parallel as to pump flow. The work tool hydraulic system shares a hydraulic tank, oil filter, and oil cooler with the hydrostatic drive system.

The lift and tilt valve spools are controlled by pilot valves. The auxiliary valve spool is controlled by two solenoid valves located in the work tool control valve group. The hydrostatic drive system charge pump provides pilot oil through a free flow check valve to the pilot system. The charge relief valve in the hydrostatic pump group limits the maximum pilot system pressure.

An accumulator provides tilt, dump, and work tool auxiliary lowering capabilities for a limited time after the engine has been shut down. Orifices in the pilot lines permit smooth control during operation of the valves. When actuated the pilot valves function as variable pressure reducing valves.

The single work tool positioner maintains the work tool in a level position only during the raising of the loader arms.

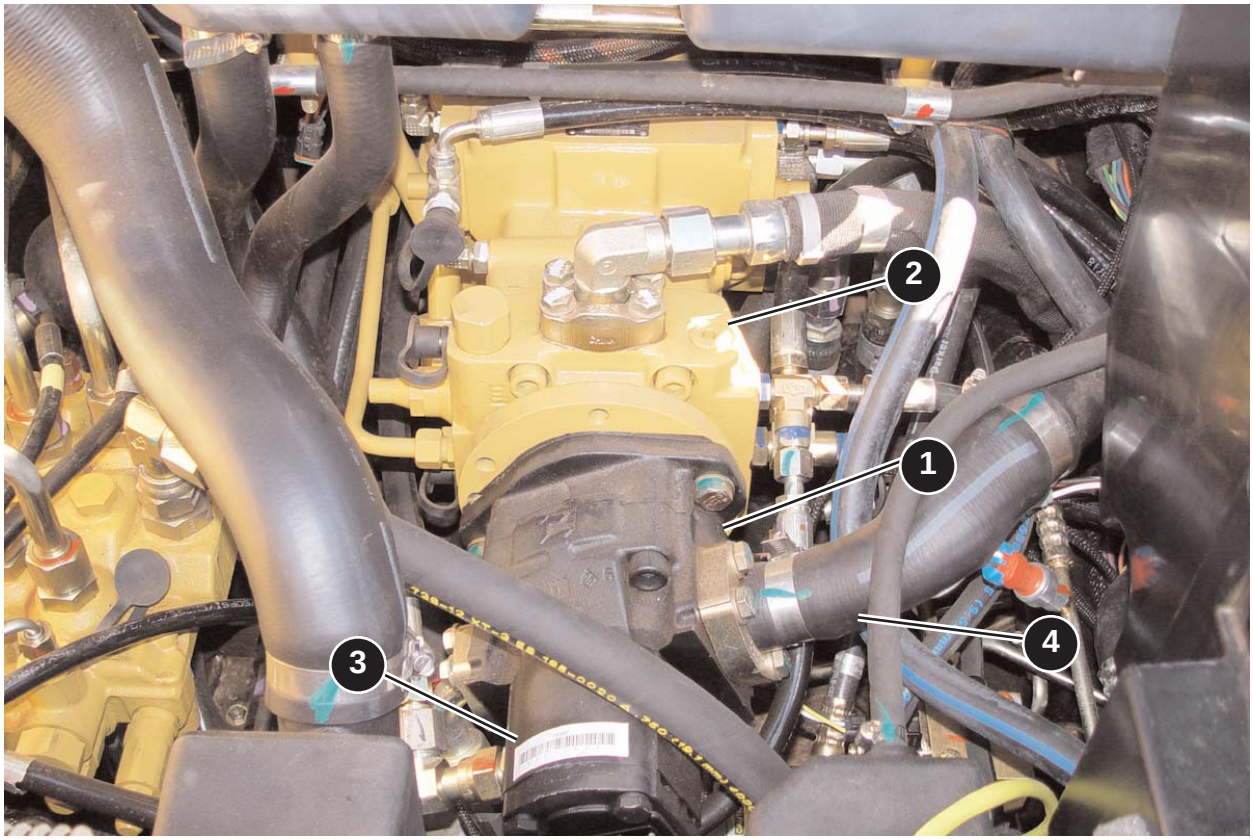


69

The multi-terrain loaders are also equipped with an open-center, pilot-operated work tool hydraulic system.

The difference in the work tool hydraulic systems is the location of the free flow check valve. On the multi-terrain loaders, the free flow check valve is on the inlet side of the hydrostatic drive pump group.

The skid steer loaders use the same free flow check valve, however, it is installed on the outlet side of the hydrostatic drive pump group.



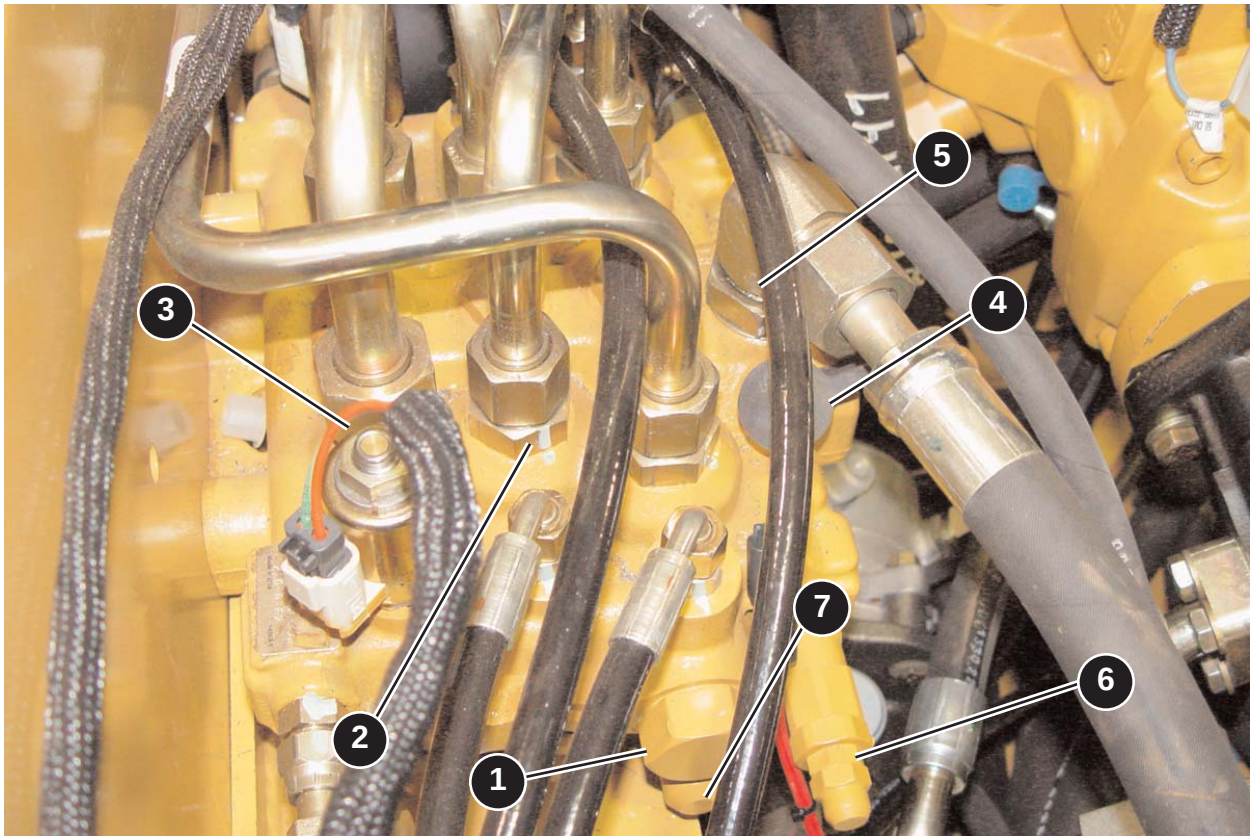
70

Component Locations

The work tool pump (1) is a gear pump that is mounted to the hydrostatic drive pump group (2).

The charge pump (3) is mounted to the work tool pump.

Hydraulic oil from the tank is drawn into the hydraulic system through the supply hose (4) connected to the top of the work tool pump.

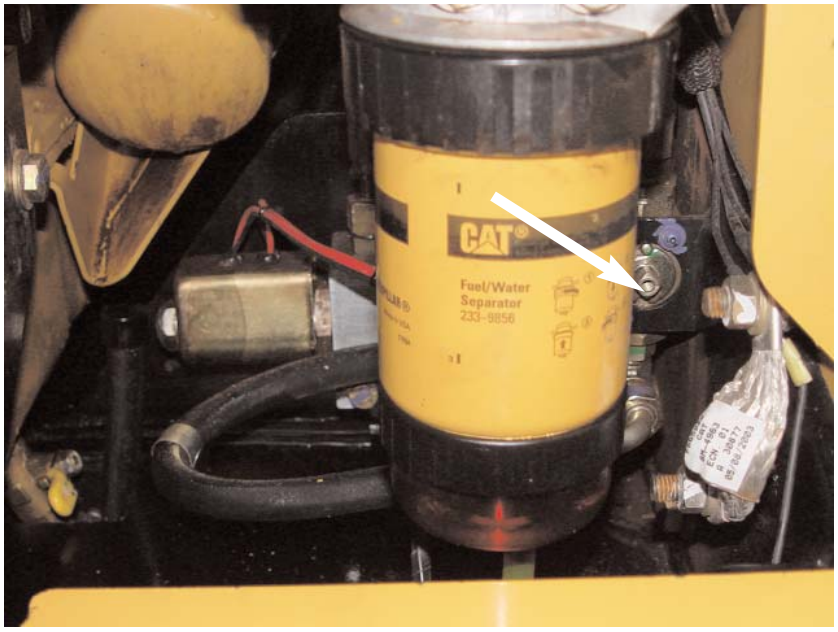


71

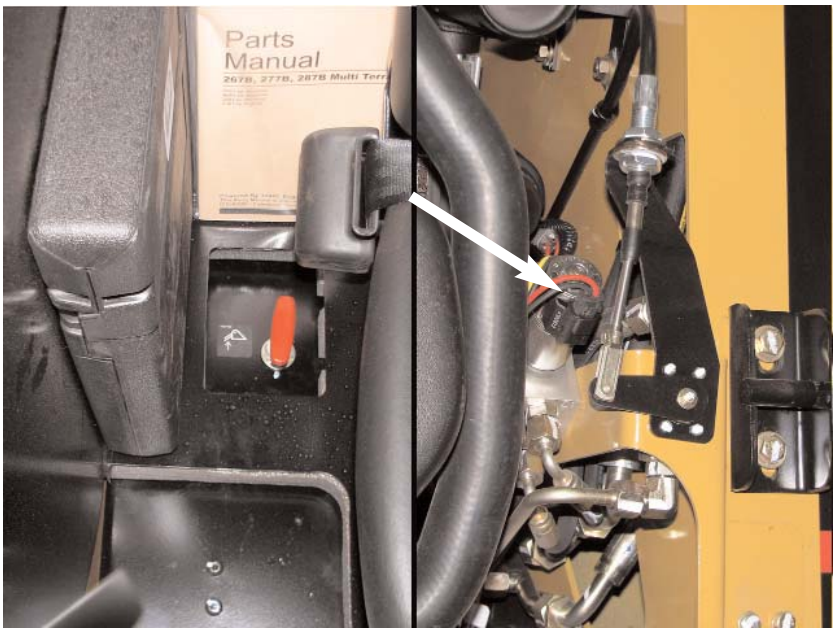
The work tool control valve group is located on the right frame rail below the cab. The control valve group controls oil flow to the lift and tilt cylinders and to the auxiliary circuit. The lift valve (1) directs oil flow to the lift cylinders to raise and lower the lift arms. The tilt valve (2) directs oil flow to the tilt cylinders to tilt the bucket or work tool. The auxiliary valve (3) directs oil through the auxiliary hoses to supply oil flow to the work tools.

The main relief valve (6) limits the maximum system pressure in the work tool hydraulic system. The lift line relief valve (7) for the head end of the lift cylinder is visible. The line relief valves not visible in this view are the tilt cylinder head and rod end line relief valve, and an auxiliary line relief valve.

Relief valve pressures can be tested at the pressure tap (4) located on the top of the work tool control valve group.



72



72A

The manual lower valve (arrow) is located on the right side of the rear compartment. The manual lower valve is used to lower the lift arms in the event of a dead engine and if the accumulator has bled down. The manual lower valve directs oil from the head end of the lift cylinders to the return manifold and to tank.

On machines built from April 2006, there is now a bypass valve handle located on the RH cab floor adjacent to the operator's seat. Consult the Operation and Maintenance Manual (OMM) for complete instructions.

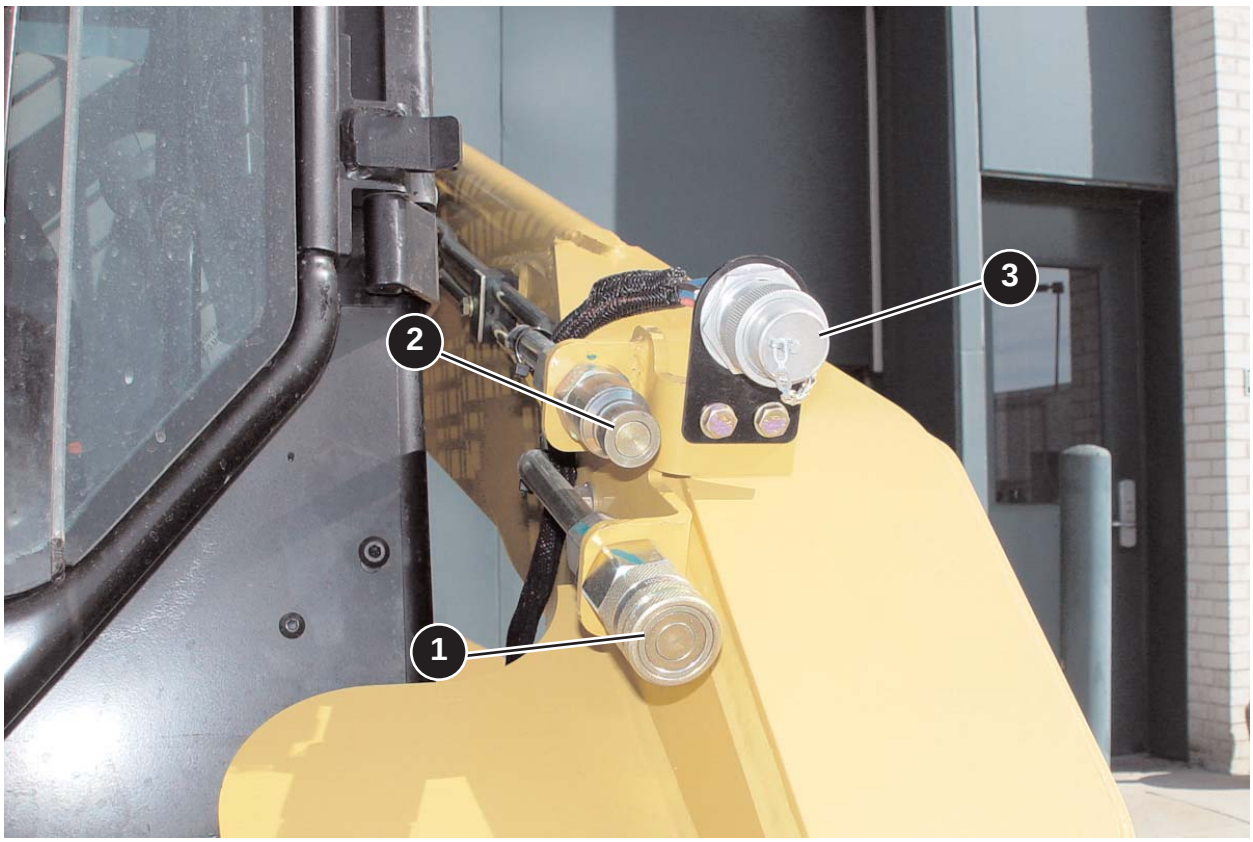
73

The lift cylinders raise and lower the lift arms. The lift cylinders are connected to the lift arms and the machine frame. The right lift arm (1) and lift cylinder (2) are shown in this illustration. The lift arm brace (3) is used to prevent the lift arms from lowering when performing maintenance.

The lift arms and lift arm cylinder bearings are lubricated on both sides of the machine. This illustration shows the lift arm grease fitting (4) and lift arm cylinder bearing grease fittings (5) on the right side of the machine.

74

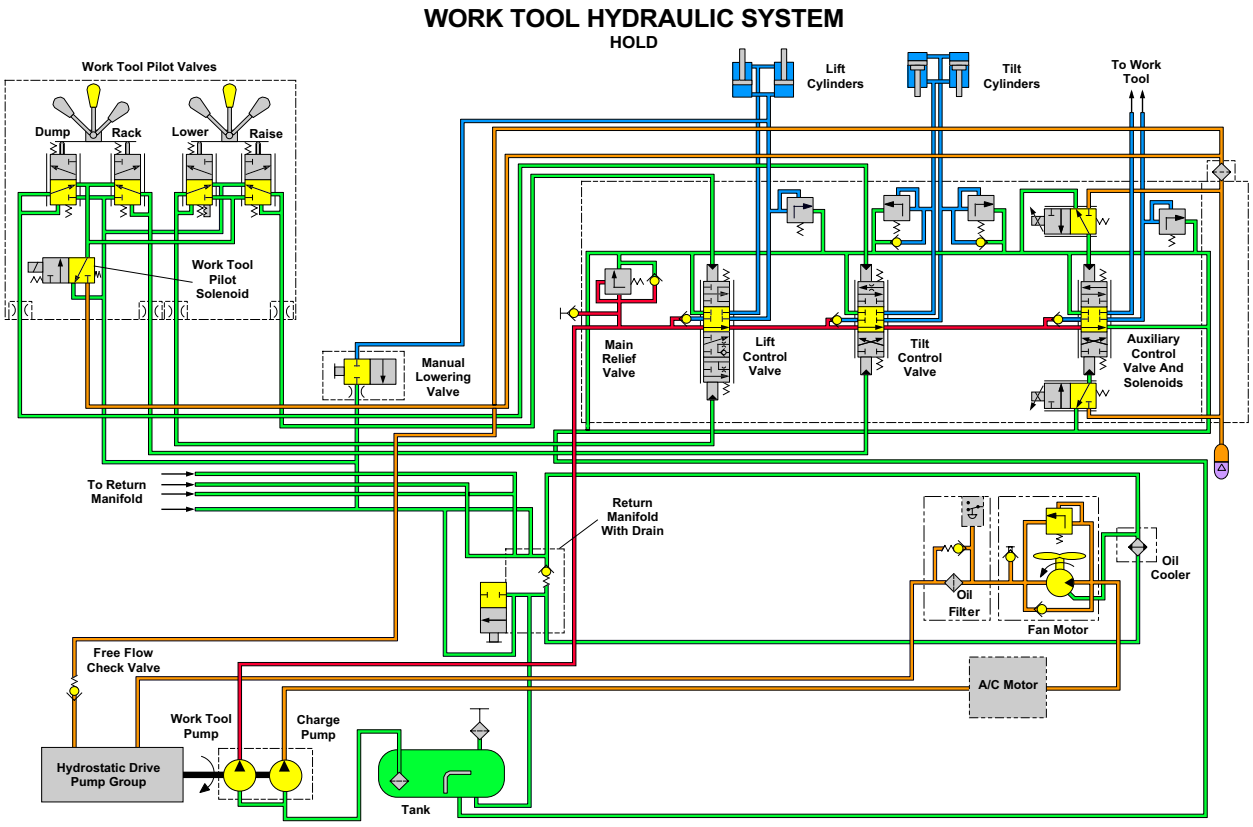
The tilt cylinders (1) control work tool coupler (2) movement. The tilt cylinders are connected to the coupler and the lift arms (3).



75

The work tool hydraulic lines are located at the front of the operator's station on the left side of the machine. The auxiliary lines allow oil flow to and from the work tools. The lines are equipped with quick disconnects. The top quick disconnect (1) supplies oil for the work tool when the "A1" control is activated. The bottom quick disconnect (2) supplies oil for the work tool when "A2" control is activated.

The Skid Steer Loaders can also be equipped with an electrical connector (3) to provide electrical power to a three-position diverter valve located on some work tools.



76

Work Tool Hydraulic System Operation

The standard work tool hydraulic system is a pilot-operated, open-center, fixed displacement system. At machine start-up with the work tool control lever in HOLD, the charge pump sends oil through the air conditioner compressor motor, the fan motor, and the oil filter to the hydrostatic drive pump group.

From the hydrostatic drive pump group, charge oil is sent to the work tool pilot valve solenoid and auxiliary solenoids in the work tool control valve group. The energized work tool pilot solenoid enables pilot oil to be available at the work tool pilot valves.

When the A1 or A2 auxiliary switch on the work tool joystick is activated, an energized auxiliary solenoid directs pilot oil to the auxiliary control valve spool in the control valve group.

The work tool pilot valve solenoid is energized by the Operator Interlock ECM and the auxiliary solenoids are energized by the Auxiliary Hydraulic ECM.

The work tool pilot valves direct pilot oil to the work tool control valve group lift and tilt spools. The more the pilot valve is shifted, the higher the pilot oil flow that is directed to the lift or tilt control valve.

The amount of pilot oil to the work tool control valve group determines the distance the spool in the control valve shifts and the amount of hydraulic oil directed to the cylinders from the pump.

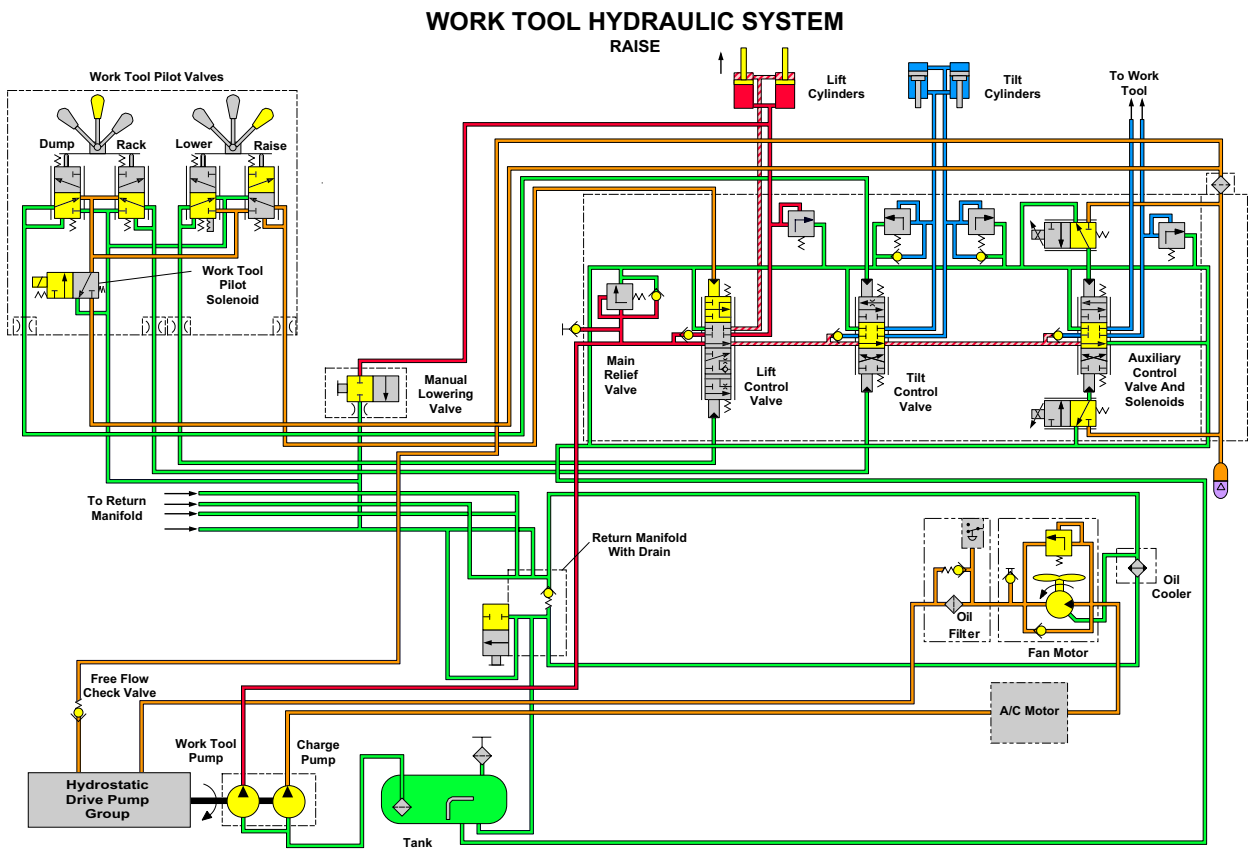
The tilt circuit is equipped with combination line relief and makeup valves for the rod and head ends of the cylinder. The lift circuit is equipped with a line relief valve and a manual lowering valve on the head end of the lift cylinder circuit.

The auxiliary circuit is equipped with a line relief valve for the two auxiliary lines. All valves are equipped with load check valves.

With all the control valve group valves in HOLD (shown), the pump supply oil flows through the center passage of each valve before returning to the tank. When in HOLD, a centering spring keeps the control spool centered. Pump supply oil enters the supply passages, flows around the control spool, and flows to the next valve. Supply oil also flows to the load check valve.

The function of the load check valve is to prevent work tool drift. When system pressure increases above the work tool circuit pressure, the load check valve opens allowing system oil to flow to the work tool.

NOTE: *The following visuals are of Skid Steer Loaders. Operation of the Multi-Terrain Loaders is the same except for the location of the free flow check valve.*



77

When the operator moves the work tool control lever to the RAISE position, the pilot control valve directs pilot oil to the top of the lift valve spool. The lift valve spool is shifted down by pilot oil which blocks the oil flow through the center of the valve to the next valve.

When supply pressure is higher than the pressure in the head end passage, pump supply oil in the supply passage opens the load check valve. Opening the load check valve allows pump supply oil to flow to the head end of the lift cylinders.

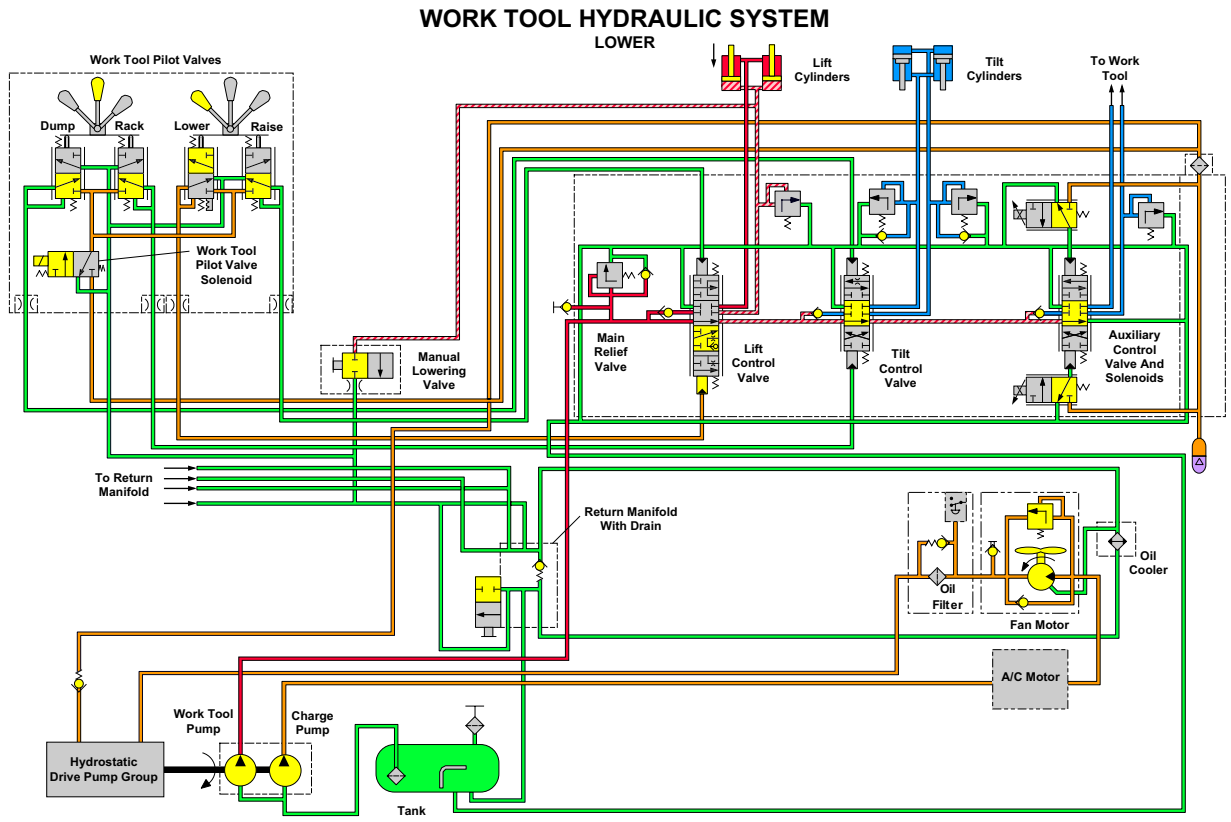
The return oil from the rod end flows through an internal passage in the lift control valve spool. The oil flowing through the internal passage is restricted creating pressure which is less than system pressure.

After flowing through the internal passage the return oil can become supply oil for the tilt control valve or auxiliary control.

If the pilot valve is only partially shifted, some pump supply oil is metered through the center of the valve to the next circuit and then to the tank (unless one of the other control valves is fully shifted).

If the lift circuit is stalled in either direction, no oil returns from the lift cylinders to become supply oil for the tilt circuit. If the lift control spool is fully shifted, there will also be no oil metered to the tilt circuit. The tilt circuit will not function until the pilot valve for the lift circuit is moved from the fully shifted position.

NOTE: *Supply oil to the tilt and auxiliary circuits are shown in pink and red stripes to reflect that the lift control valve is of series flow design.*

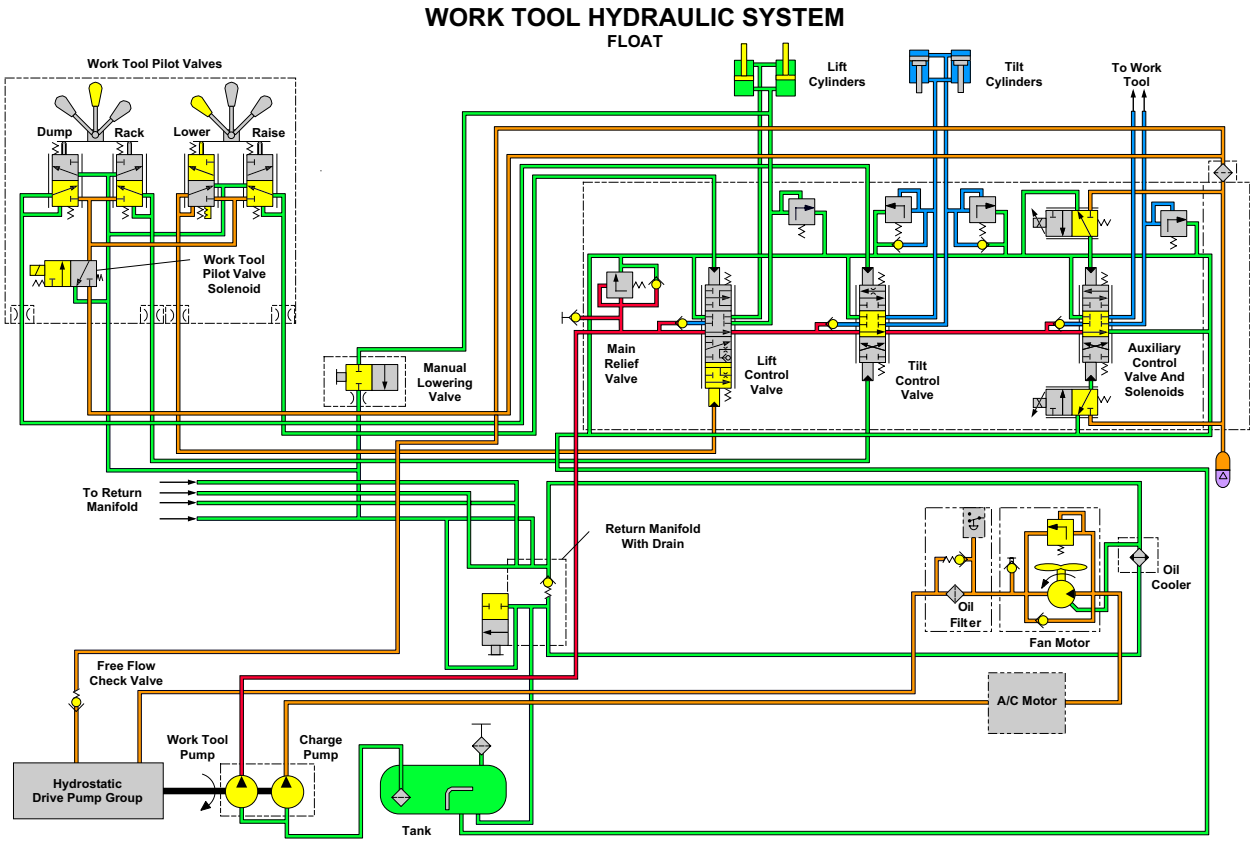


78

When the operator moves the work tool control lever to the LOWER position, the pilot control valve directs pilot oil below the lift valve spool. The lift valve spool is shifted up which blocks the oil flow through the center of the valve to the next valve.

When supply pressure is higher than the pressure in the rod end passage, pump supply oil in the supply passage opens the load check valve. Opening the load check valve enables pump supply oil to flow to the rod end of the lift cylinders. The lift cylinders retract.

The return oil from the head end flows through an internal passage in the lift control valve spool. The oil flowing through the internal passage is restricted creating pressure which is less than system pressure. After flowing through the internal passage the return oil becomes supply oil for the tilt control valve or auxiliary control valve before returning to the tank.

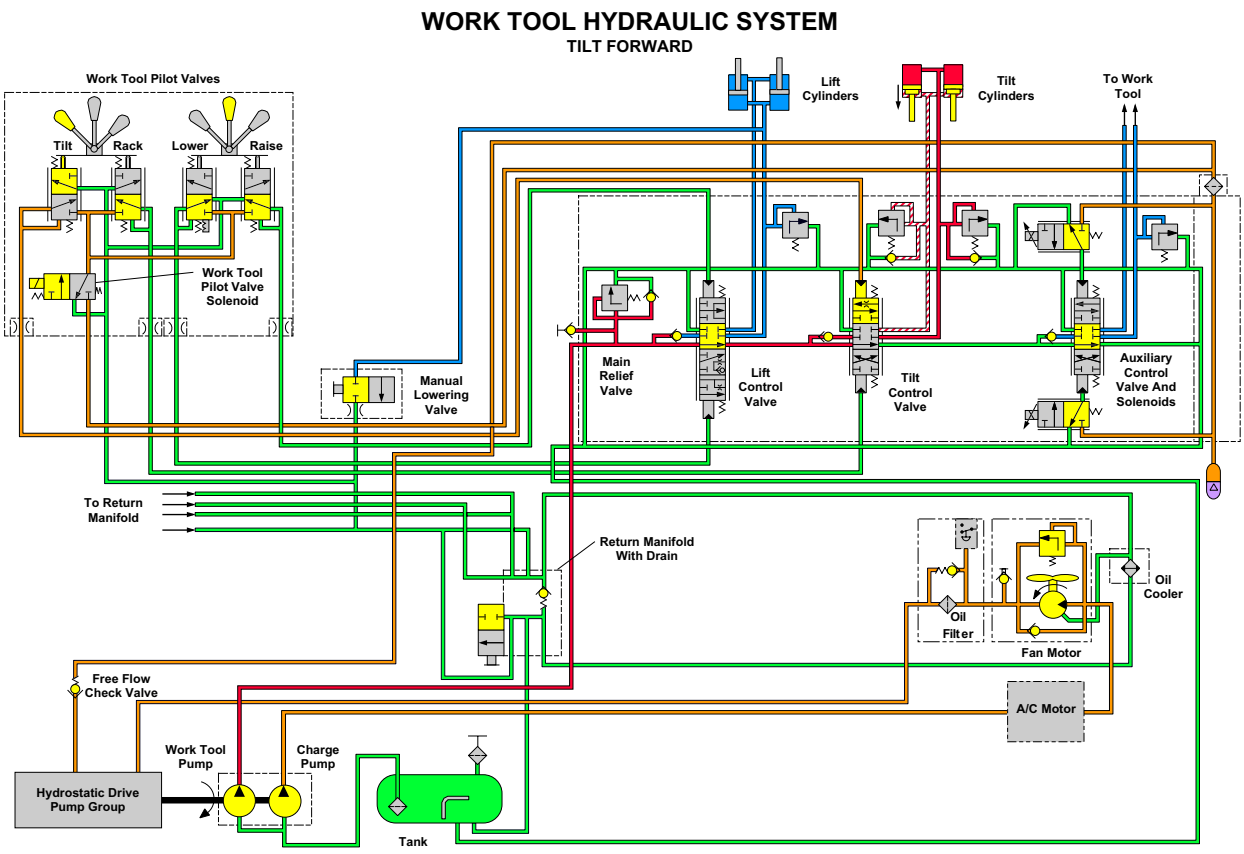


79

When the operator moves the work tool control lever to the FLOAT position for the lift circuit, an energized detent coil in the pilot valve will hold the lever in detent. Pilot oil enters the pilot passage below the main control spool and shifts the spool fully up.

Pump supply oil enters the supply passages and flows through the center passage of the control valve and to the next valve. The oil in the supply passage to the lift cylinders is blocked by the control spool, so the load check valve remains seated. The control spool opens passages between both work ports and the tank.

The weight of the work tool and lift arms lowers the work tool to the ground. Since the head end and the rod end of the lift cylinders are open to the tank, the work tool floats on the ground. FLOAT is typically used for back dragging or back filling.

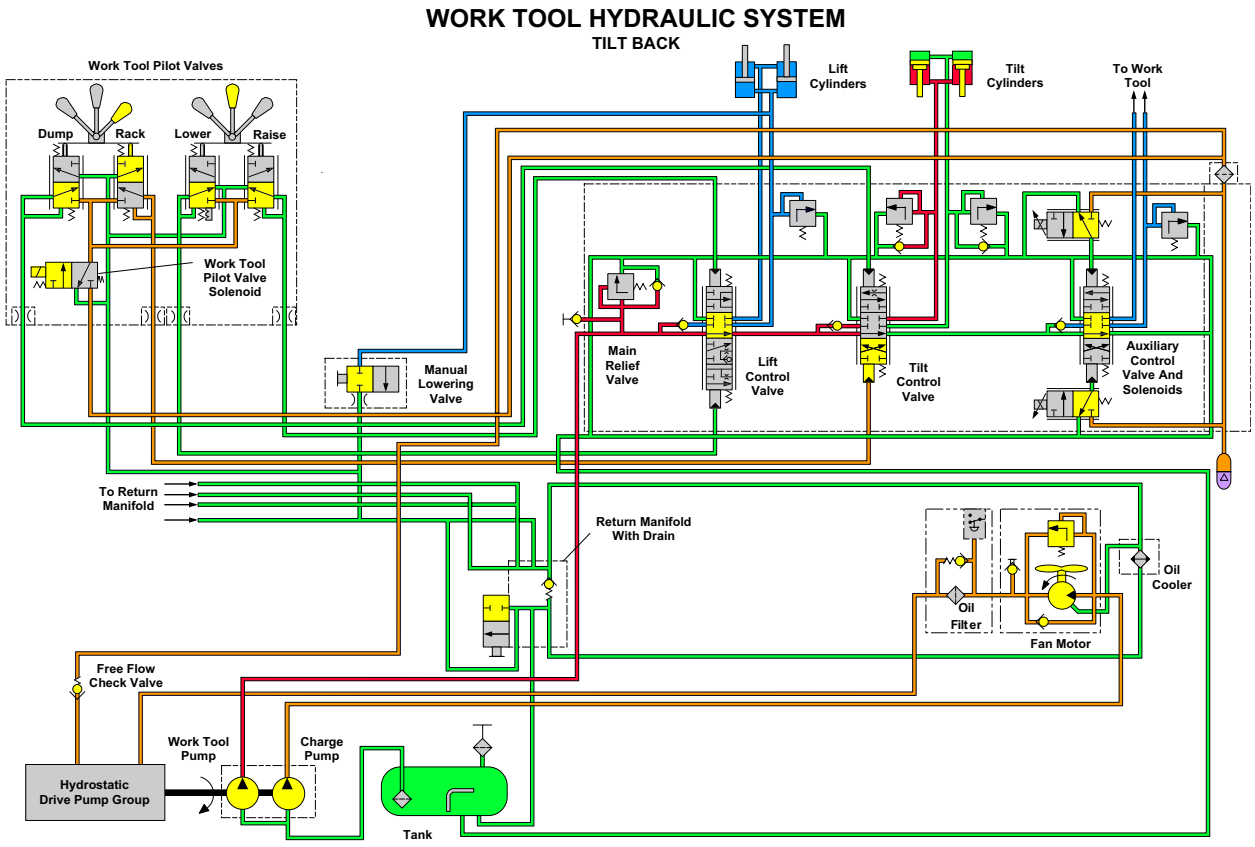


80

When the operator moves the work tool control lever to the TILT FORWARD position, the pilot control valve directs pilot oil to the top of the tilt valve spool. The tilt valve spool is shifted down which blocks the oil flow through the center of the valve to the next valve.

When supply pressure is higher than the pressure in the head end passage, pump supply oil in the supply passage opens the load check valve. Opening the load check valve allows pump supply oil to flow through to the head end of the tilt cylinders. The work tool tilts forward.

Oil from the rod end of the tilt cylinders flows back through the tilt control valve and to the tank.

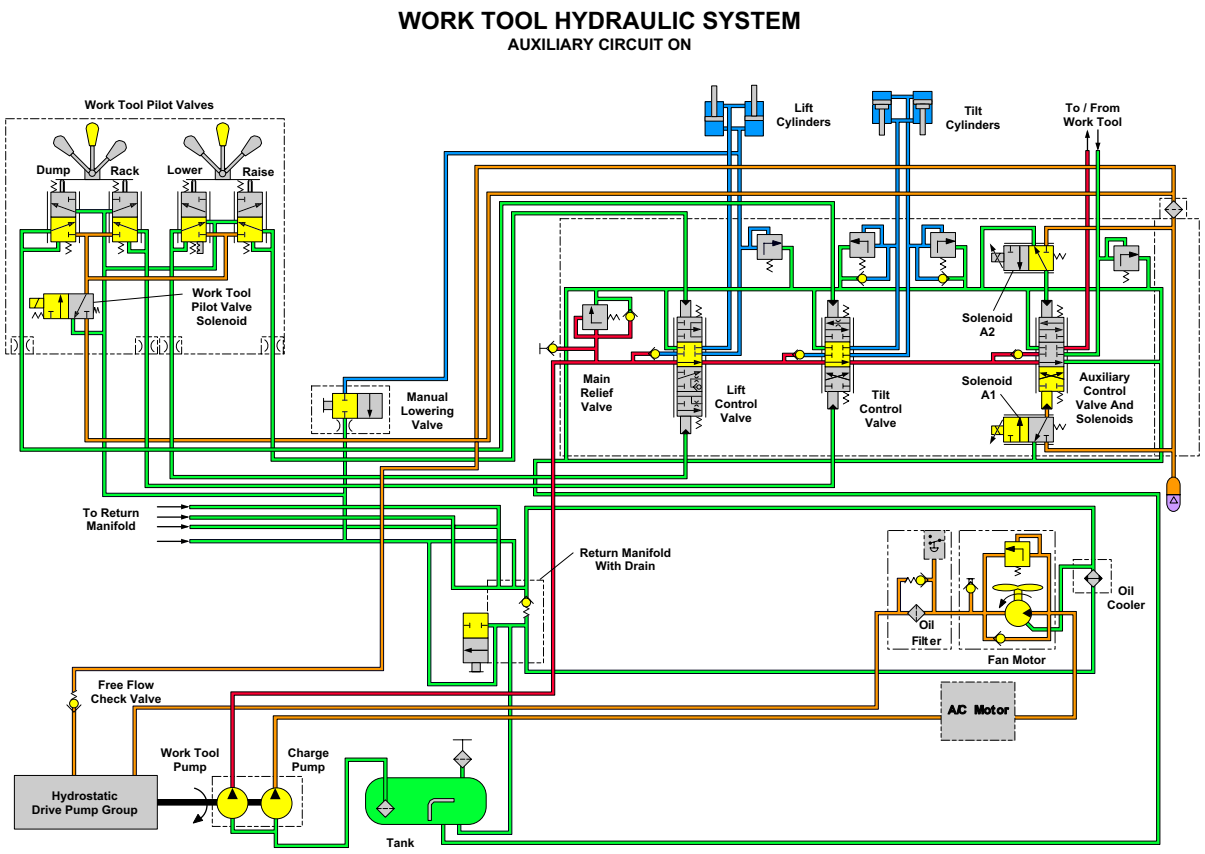


81

When the operator moves the work tool control lever to the TILT BACK position, the pilot control valve directs pilot oil below the tilt valve spool. The tilt valve spool is shifted up which blocks the oil flow through the center of the valve to the next valve.

When supply pressure is higher than the pressure in the rod end passage, pump supply oil in the supply passage opens the load check valve. Opening the load check valve allows pump supply oil to flow through to the rod end of the tilt cylinders. The work tool tilts back.

Oil from the head end of the tilt cylinders flows back through the control valve and to the tank.



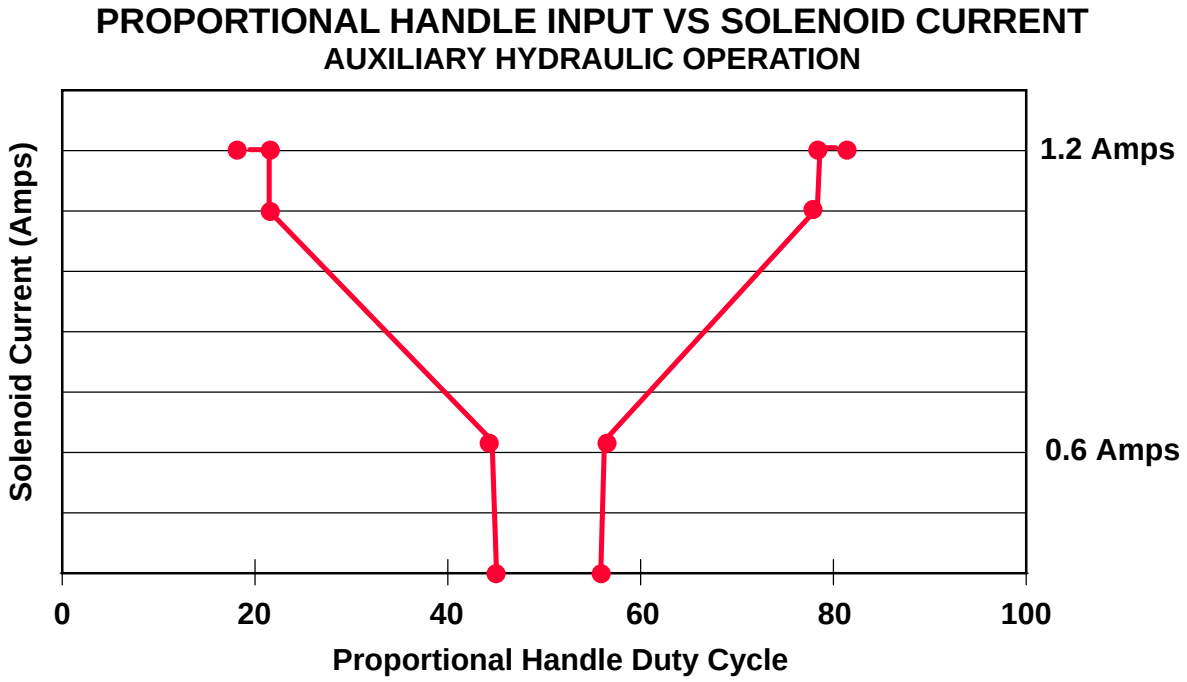
82

Auxiliary Hydraulic System

The auxiliary hydraulic system provides oil flow for work tools through the hydraulic lines mounted on the left lift arm. Supply oil from the work tool pump flows to the work tool when the auxiliary control spool is shifted. The control spool shifts when the Auxiliary Hydraulic ECM energizes one of the auxiliary solenoids, allowing pilot oil pressure to act on the control spool. The auxiliary hydraulic system can be equipped with ON/OFF or proportional control.

When equipped with ON/OFF control, the Auxiliary Hydraulic ECM directs a fixed current to one of the auxiliary solenoids when the operator depresses one of the momentary switches on top of the work tool control lever. The fixed current fully shifts the auxiliary solenoid valve allowing full pilot pressure to act on the control spool. No flow modulation is possible.

When equipped with proportional control, the Auxiliary Hydraulic ECM directs a variable Pulse Width Modulated (PWM) signal to the auxiliary solenoids. The resulting current partially shifts the auxiliary solenoid, allowing metered pilot pressure to act on the control spool. The control spool shifts partially, allowing reduced flow to the auxiliary circuit.

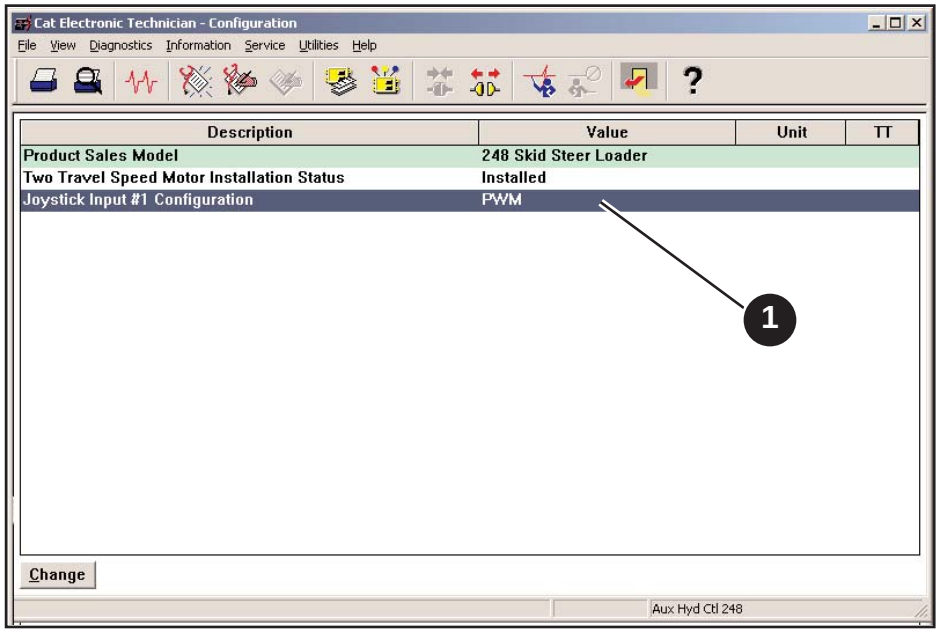


83

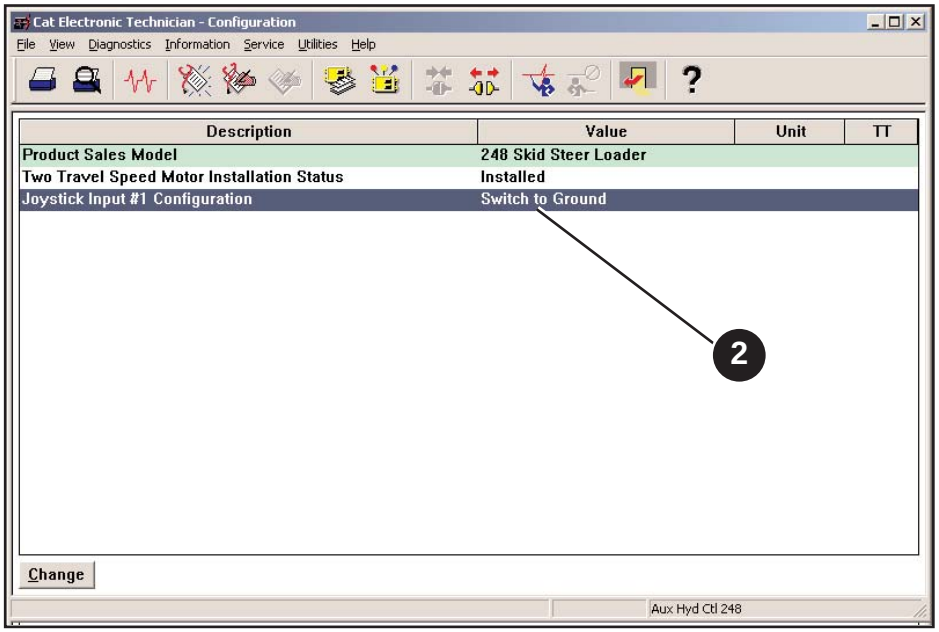
The standard auxiliary hydraulic system provides ON/OFF control of the auxiliary hydraulic circuit. Optionally, the machine can be equipped with proportional control of the auxiliary hydraulic circuit. Different joysticks are required for each system.

Two solenoids are used to control the auxiliary control spool in the work tool control valve. The solenoids are electronically controlled by the Auxiliary Hydraulic ECM.

The Auxiliary Hydraulic ECM directs a proportional signal or constant signal to the solenoids depending on the how the system is configured. Caterpillar ET is required to configure the Auxiliary Hydraulic ECM.



84

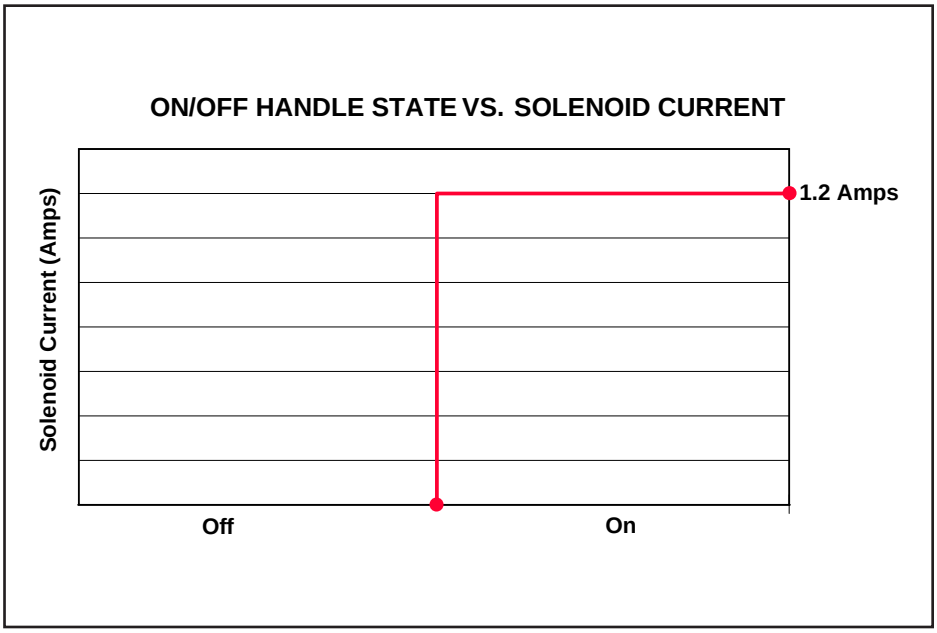


85

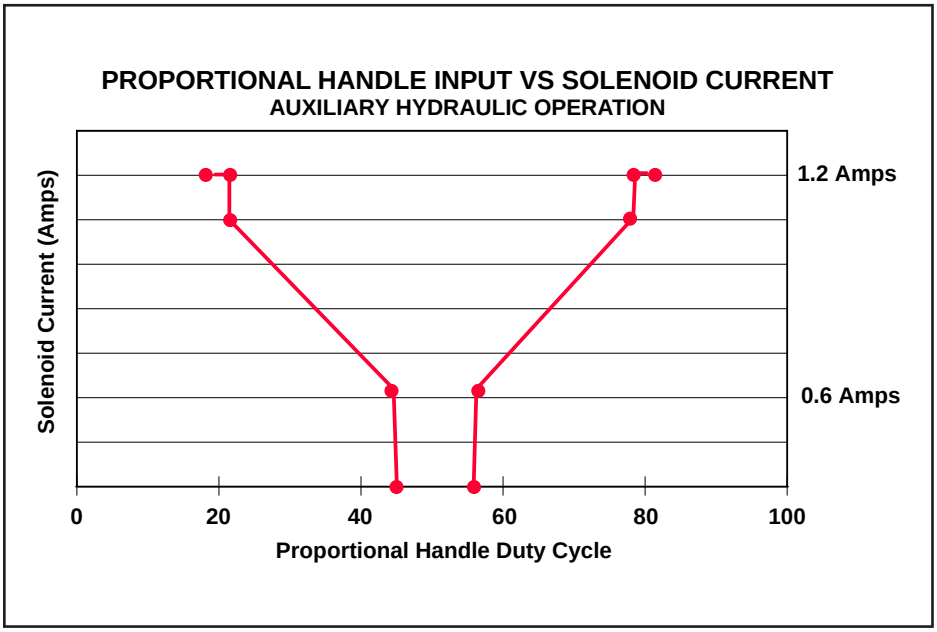
The "Joystick Input #1 Configuration" parameter in the Cat ET "Configuration" screen for the Auxiliary Hydraulic ECM must be configured to use either the ON/OFF or proportional joysticks.

For ON/OFF control, the "Joystick Input #1 Configuration" Parameter should be set to "Switch to Ground" (1). For proportional control, the Joystick Input #1 Configuration Parameter should be set to "PWM" (2).

***NOTE*:** *For proportional control of the auxiliary hydraulics to function properly, the machine must be equipped with a work tool lever that is equipped with the proportional control.*



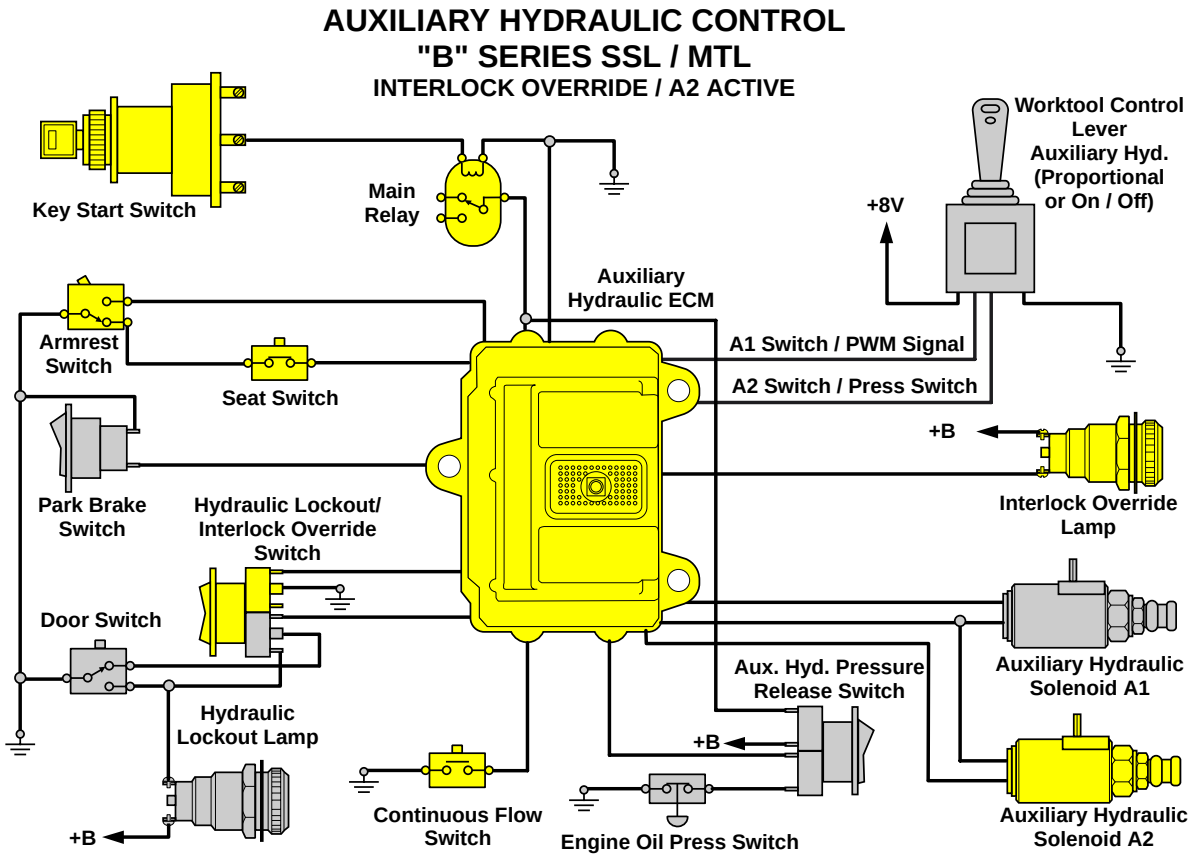
86



87

These illustrations show the amount of current that is directed to the auxiliary solenoids by the Auxiliary Hydraulic ECM for ON/OFF and proportional control. The maximum current for the auxiliary hydraulic system is 1.2 Amps.

When the ON/OFF switches are used, the current to one of the solenoids is immediately brought to the maximum when the switch is closed. For proportional control, the Auxiliary Hydraulic ECM monitors the pulse width modulation (PWM) signal from the sensor. When the duty cycle from the sensor is 50 ± 5%, the Auxiliary Hydraulic ECM directs no current to either solenoid. When the operator actuates the sensor, the duty cycle changes. The Auxiliary Hydraulic ECM changes the current to one of the solenoids as shown in the second illustration. There is no calibration for the proportional handle.



88

The continuous flow and interlock override function allows the operator to continuously operate the auxiliary hydraulic circuit without having to actuate the proportional or ON/OFF switches. To enable the continuous flow function, the operator must first use the auxiliary proportional or ON/OFF switches to the desired flow rate to the work tool. Once this rate has been established, the tool is rotating at the desired speed, the operator must press and release the continuous flow switch. The auxiliary proportional control or ON/OFF switch must be returned to its NEUTRAL state within one second after the continuous flow switch has been depressed. If the auxiliary proportional control or ON/OFF switch is not returned to its NEUTRAL position within one second, the continuous flow command is ignored by the Auxiliary Hydraulic ECM.

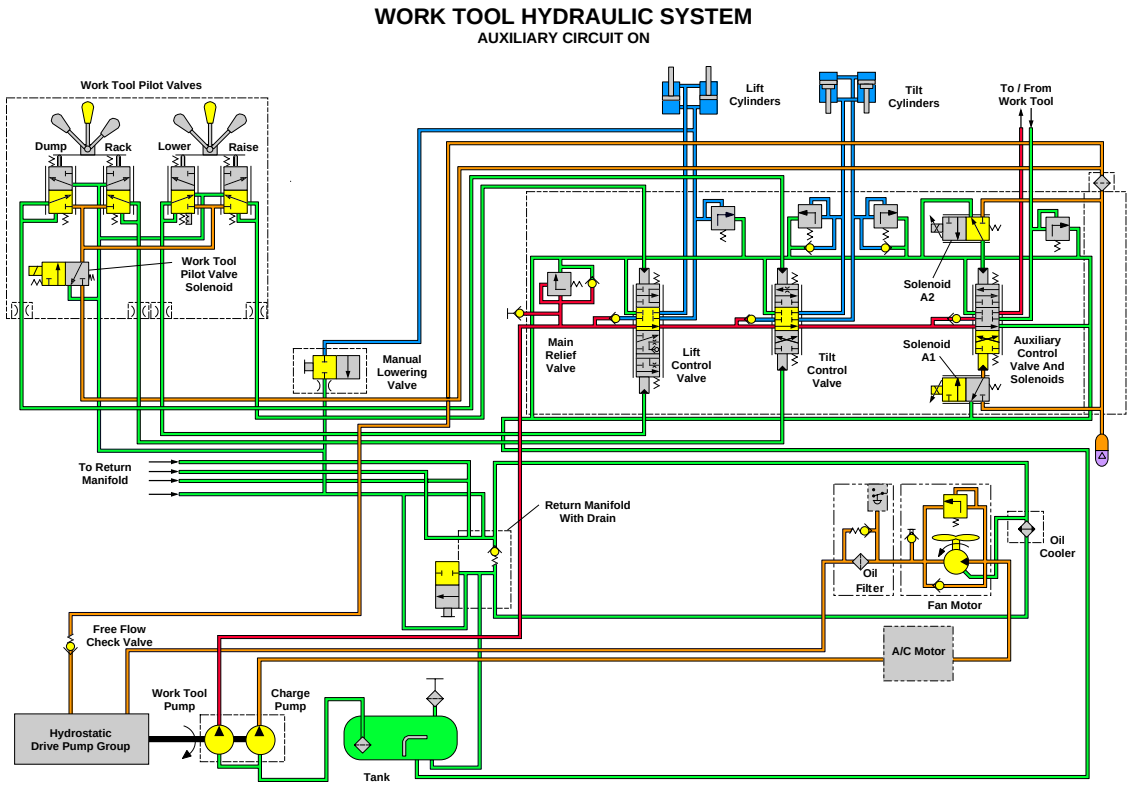
Once the continuous flow has been set, depressing and releasing the interlock override switch activates the interlock override. This allows the operator to exit the machine and leave the auxiliary hydraulic system activated.

To discontinue the use of the continuous flow feature, the operator must actuate the auxiliary proportional control or ON/OFF switches or depress and release the continuous flow switch. The hydraulic lockout switch or opening the operator's door will also disable the feature.

The continuous flow and interlock override switches are normally open, momentary switch-to-ground switches. If the Auxiliary Hydraulic ECM detects the ground signal for either switch for more than 30 seconds, the ECM determines that the switch is shorted to ground and generates a fault.

In the event of a short to ground on the continuous flow switch circuit, the Auxiliary Hydraulic ECM disables the continuous flow feature. Normal proportional tool control will still function.

In the event of a short to ground on the interlock override switch circuit, the Auxiliary Hydraulic ECM disables the interlock override function. Normal proportional tool control and continuous flow will still function.



89

When the right side of the auxiliary circuit control switch is depressed on the work tool lever, the Auxiliary Hydraulic ECM energizes auxiliary solenoid A2. Solenoid A2 directs pilot oil to the bottom of the auxiliary control valve. The auxiliary control valve spool moves up.

Pump supply oil pressure in the auxiliary control valve supply passage opens the load check valve. Opening the load check valve allows pump supply oil to flow through the auxiliary line to the work tool.

The work tool return oil flows back through the other auxiliary line, the control valve, and to the tank.

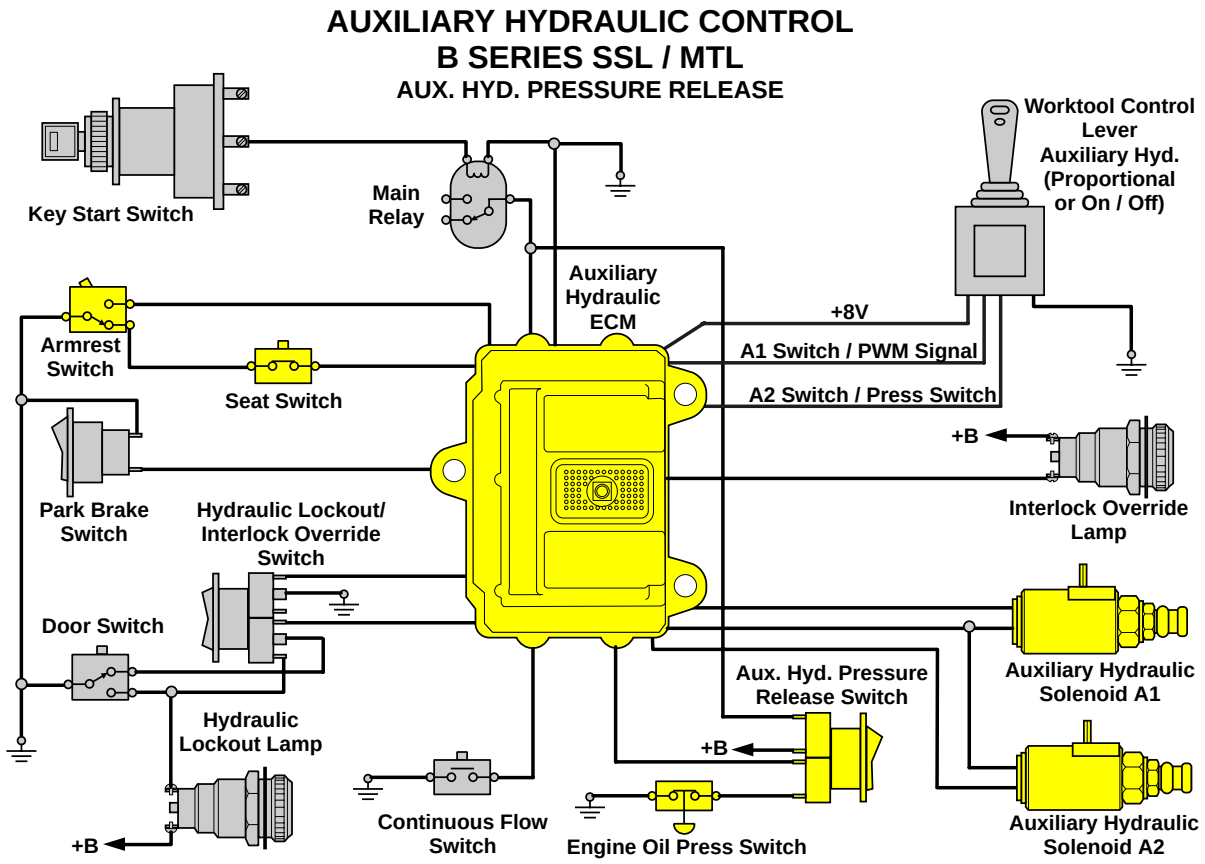
When the left side of the auxiliary circuit control switch is depressed on the work tool lever, the Auxiliary Hydraulic ECM energizes auxiliary solenoid A1.

Solenoid A1 directs pilot oil to the top of the auxiliary control valve. The auxiliary control valve spool moves down and directs oil from the pump through the auxiliary line to the work tool.

90

Depressing the auxiliary hydraulic pressure release switch (arrow) releases residual pressure in the auxiliary hydraulic lines to aid in connecting and disconnecting to the work tool.

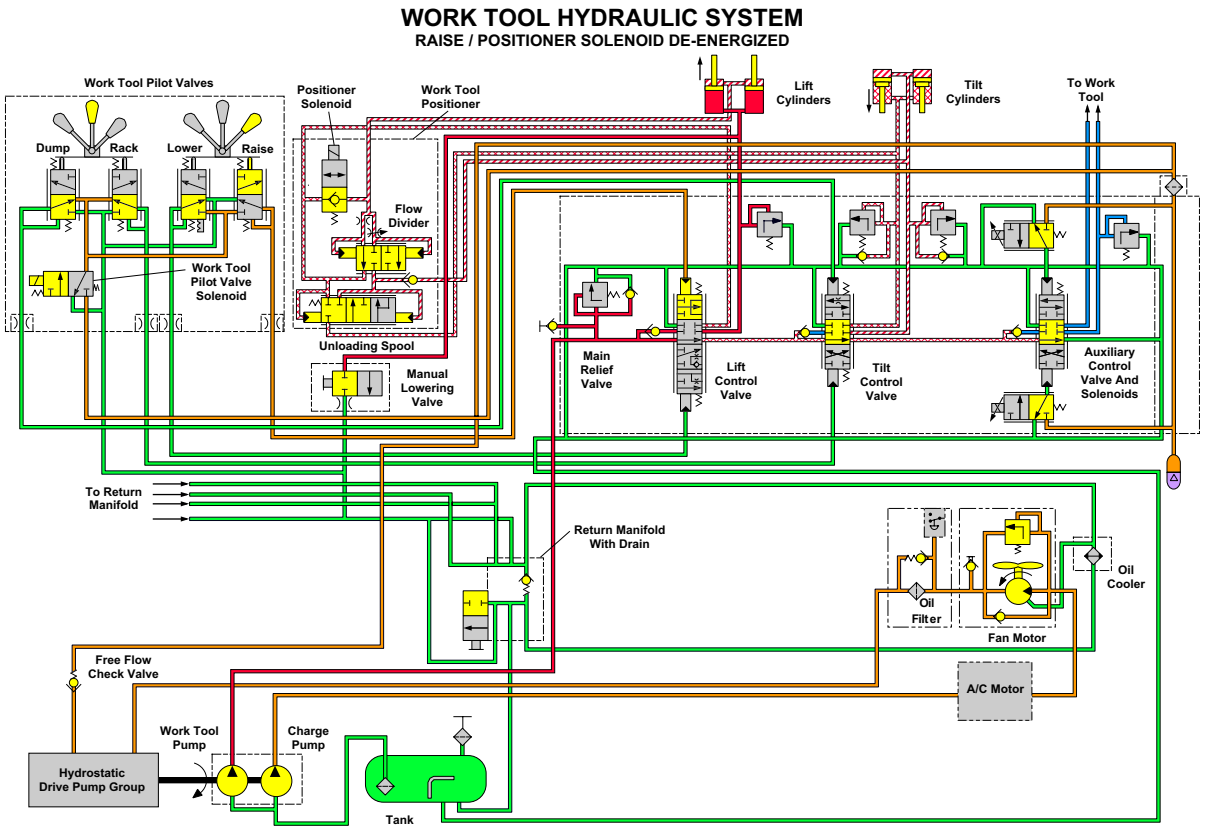
Before activating the auxiliary hydraulic pressure release switch, the machine must be started in order to charge the work tool pilot accumulator. Turn the key start switch to the OFF position. With the armbar down and the seat switch activated, slide the red tab upward and depress the bottom of the auxiliary hydraulic pressure release switch and hold for 5 seconds. The switch will then energize the Auxiliary Hydraulic ECM. The ECM will then energize the A1 solenoid for 2 seconds and then the A2 solenoid for 2 seconds.



91

To release the pressure in the auxiliary hydraulic lines (A1 and A2), start the machine in order to charge the work tool pilot accumulator. Turn the machine off and depress the auxiliary hydraulics pressure release switch for five seconds.

The auxiliary hydraulics pressure release switch sends battery voltage to power up the Auxiliary Hydraulic ECM and sends a grounded signal to the ECM via the engine oil pressure switch. The Auxiliary Hydraulic ECM will also receive signals from the armrest switch and the seat switch. When these inputs are seen by the Auxiliary Hydraulic ECM, the ECM will energize the auxiliary hydraulic solenoids for two seconds each. This will release the pressure in the auxiliary hydraulic circuits (A1 and A2).



92

Work Tool Self-Level Operation

The self-level option enables the work tool to maintain its current position while being raised.

The following components are part of the work tool positioner.

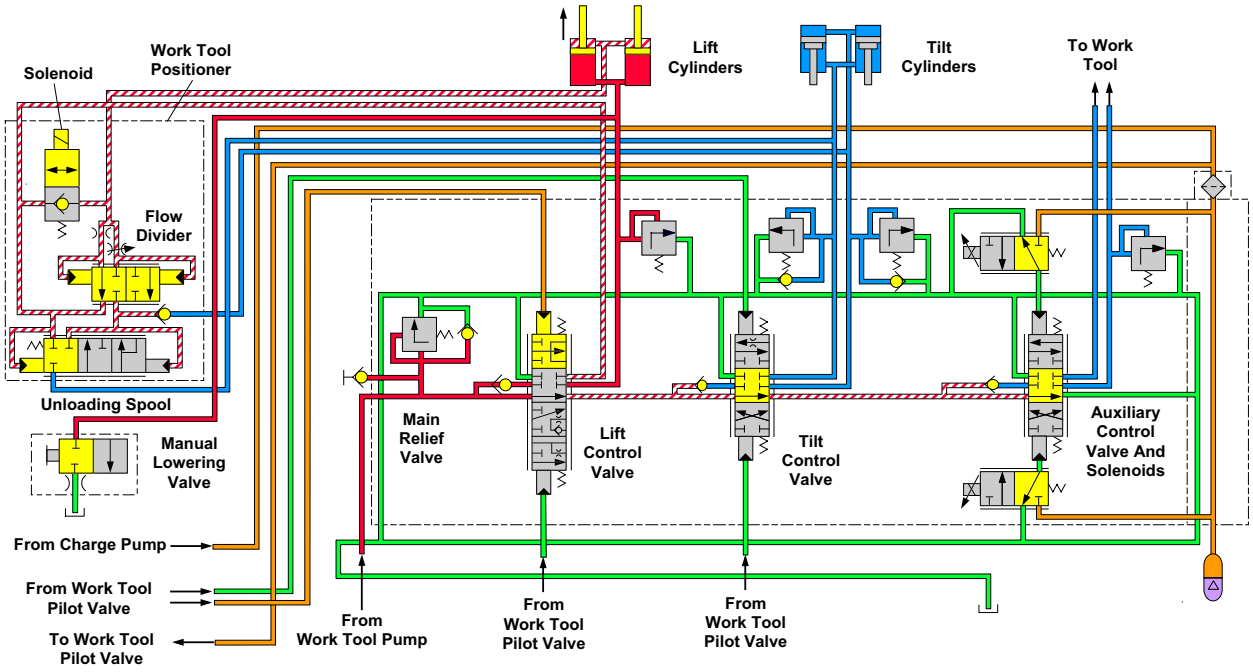
- **Flow divider valve:** The flow divider valve proportionally splits the oil flow from the rod end of the lift cylinder to the lift control valve and the head end of the tilt cylinder.

- **Unloading spool:** The unloading spool prevents the tilt cylinder rod from extending and dumping the bucket during the self-level cycle.

- **Solenoid:** The solenoid controls the flow of oil in the work tool positioner valve.

WORK TOOL HYDRAULIC SYSTEM

RAISE / POSITIONER SOLENOID ENERGIZED



93

When the work tool positioner solenoid is ENERGIZED, the lift and tilt circuits operate independently of each other.

When the operator moves the work tool control lever to the RAISE position and the work tool positioner solenoid is ENERGIZED, the pilot control valve directs pilot oil to the top of the lift control valve spool. The lift control valve spool is shifted down which blocks the oil flowing through the center passage of the valve to the next valve.

When supply pressure is higher than the pressure in the head end passage, pump supply oil in the supply passage opens the load check valve. Opening the load check valve allows pump supply oil to flow to the head end of the lift cylinders.

With the solenoid ENERGIZED, an internal passage in the work tool positioner valve is opened permitting return oil from the lift cylinder rod end to flow through it, bypassing the flow divider and unload spool.

The return oil then flows to an internal passage in the lift control valve spool.

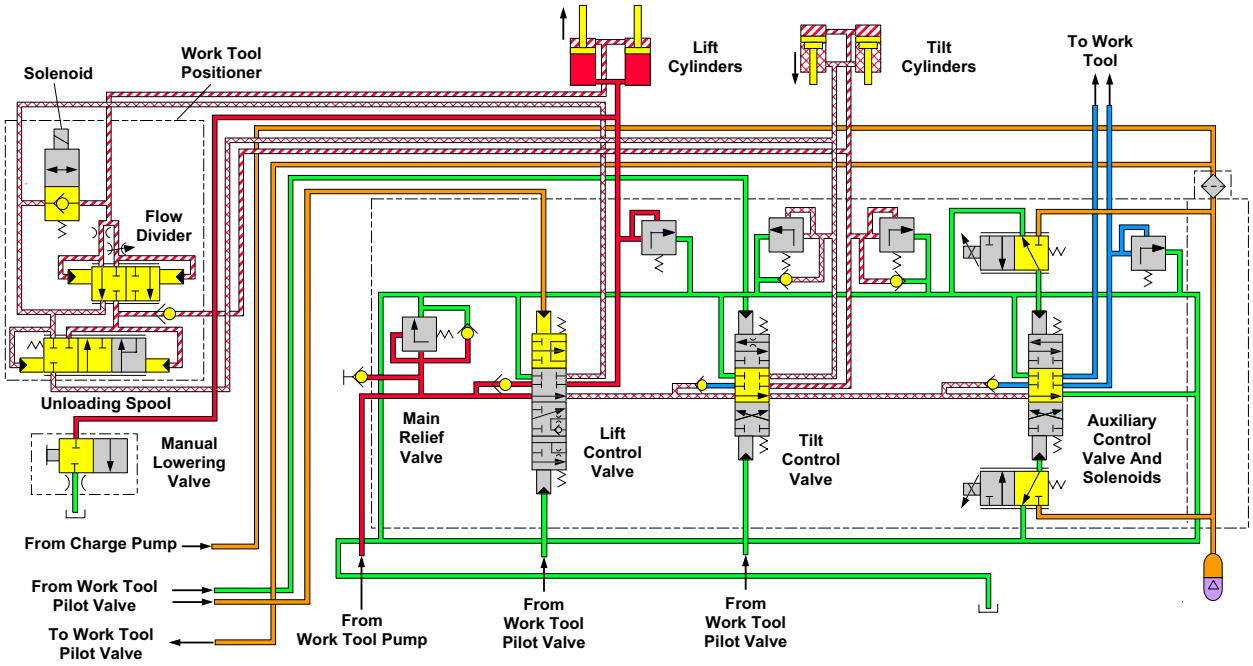
The oil flowing through the internal passage in the lift control valve is restricted creating a pressure which is slightly less than system pressure. After flowing through the internal passage

the return oil becomes second reduced pressure oil which becomes supply oil for the tilt control valve or auxiliary control valve before returning to the tank.

If the pilot valve is only partially shifted, some pump supply oil is metered through the center of the valve to the next circuit and then to the tank (unless one of the other control valves is fully shifted).

WORK TOOL HYDRAULIC SYSTEM

RAISE / SOLENOID DE-ENERGIZED



94

When the work tool positioner switch is disengaged, and the lift cylinders are extending, oil from the rod end of the lift cylinders flows into the work tool positioner through a fixed orifice and variable orifice in the flow divider. The proportion of the flow split is determined by the size of the variable orifice. The variable orifice can be adjusted to maintain the proportional flow of oil.

Oil flows through the variable orifice to the head end of the tilt cylinders and to the tilt control valve. The tilt cylinders resist movement because the tilt control valve is in the HOLD position. This resistance increases the oil pressure at the right side of the unloading spool, shifting it to the center position.

With the unloading spool in the center position, oil from the rod end of the tilt cylinders flows through the unloading spool allowing the tilt cylinder rods to extend.

As the tilt cylinders extend, the pressure in the tilt cylinder head end decreases slightly, resulting in a decrease in pressure on the right end of the unloading spool.

The reduction of oil pressure at the right end of the unloading spool enables the spring at the left end to move the unloading spool to the right, thus blocking the oil flow from the rod end of the tilt cylinders.

The unloading spool moves back and forth to modulate the pressure in the tilt cylinder during the RAISE mode of the lift cylinders. This action permits the tilt cylinders to extend gradually, which keeps the work tool in a level position.

When the operator releases the work tool control lever, the centering spring in the left pilot chamber returns the lift control valve spool to the HOLD position.

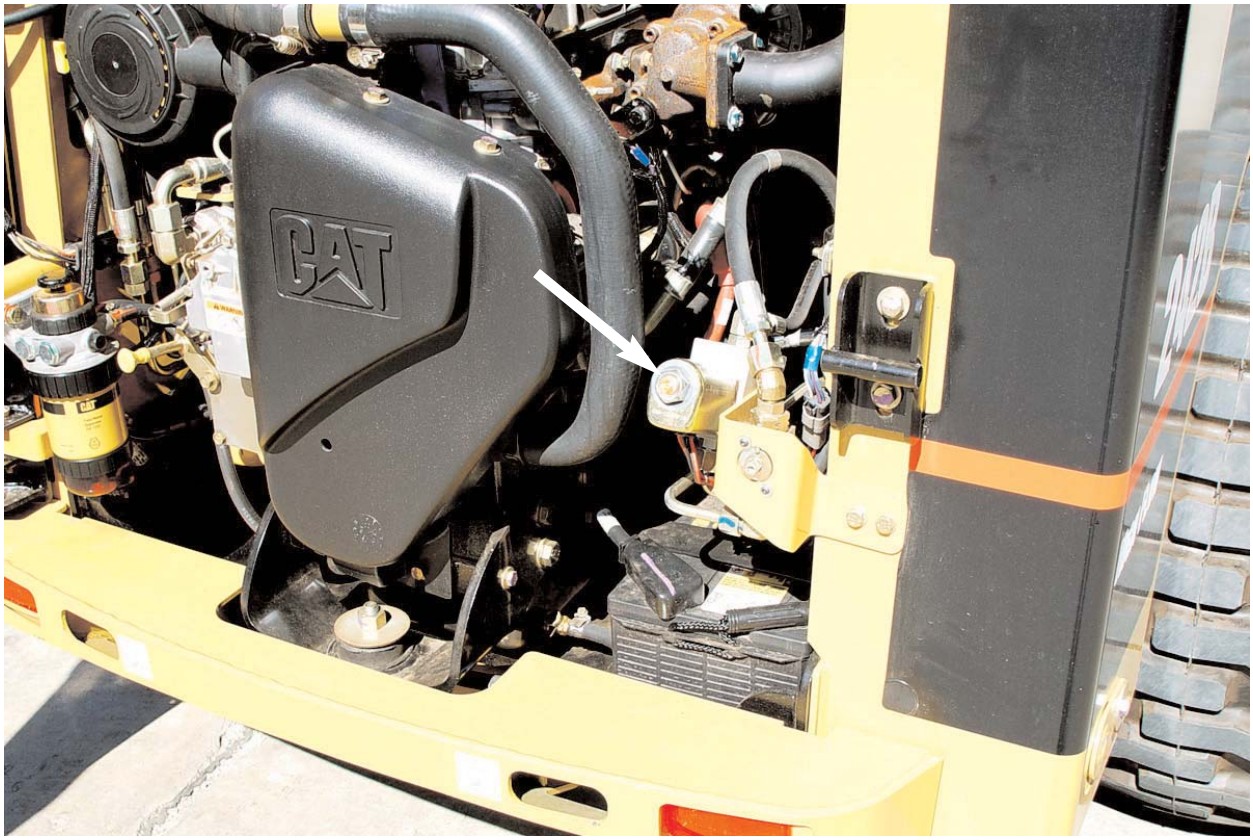
95

Hydraulic Work Tool Coupler System

The optional hydraulic work tool coupler allows the operator to engage and disengage the work tool without having to exit the machine. Two hydraulic cylinders (arrows) replace the handles used on the manual coupler. The cylinders raise and lower the chrome wedge pins to disengage and engage the work tool.

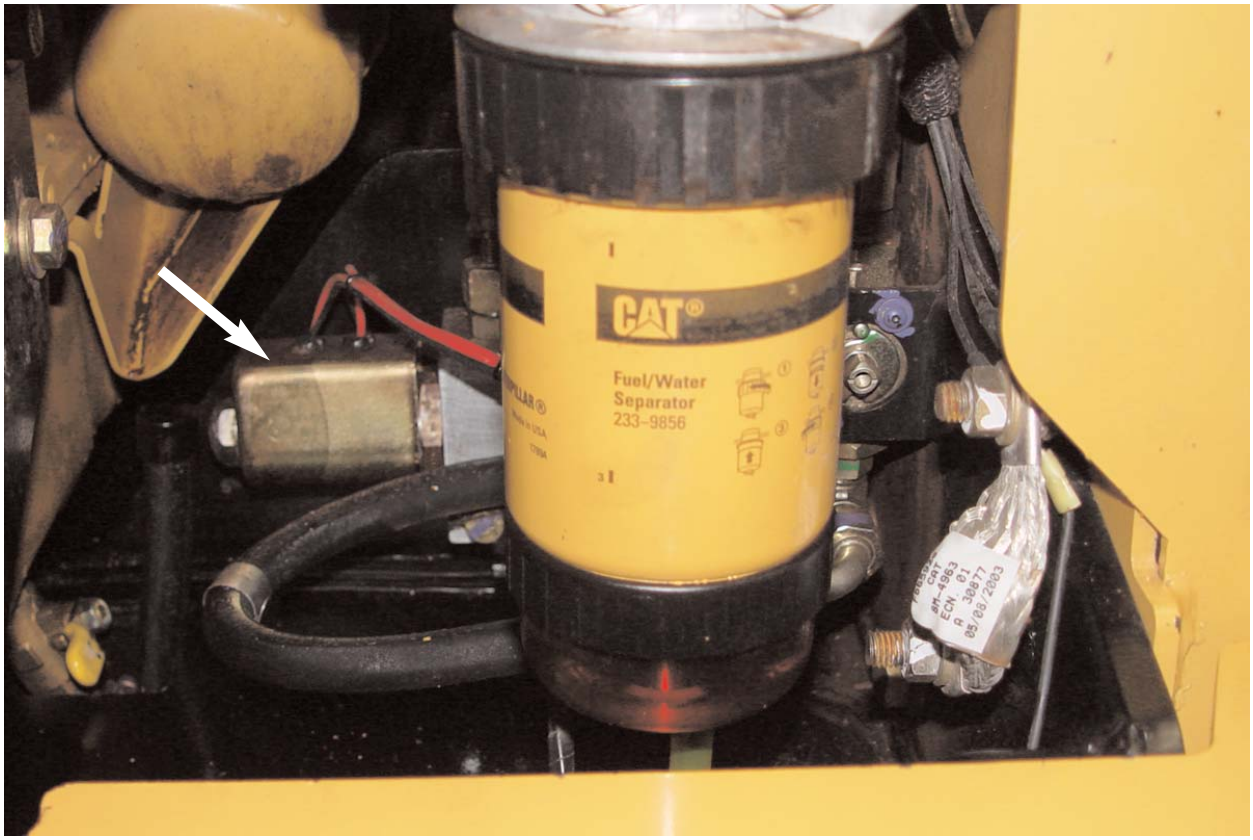
96

The rocker switch (1) controls the engagement of the work tool coupler pins. Depressing the top of the rocker switch causes the coupler pins to engage. Slide the red tab (2) upward and depress the bottom of the rocker switch to disengage the pins.



97

The hydraulic work tool cylinders are controlled by a solenoid valve (arrow) located at the rear of the machine. This illustration shows the coupler solenoid valve's location on machines equipped with the 3024C Engine.

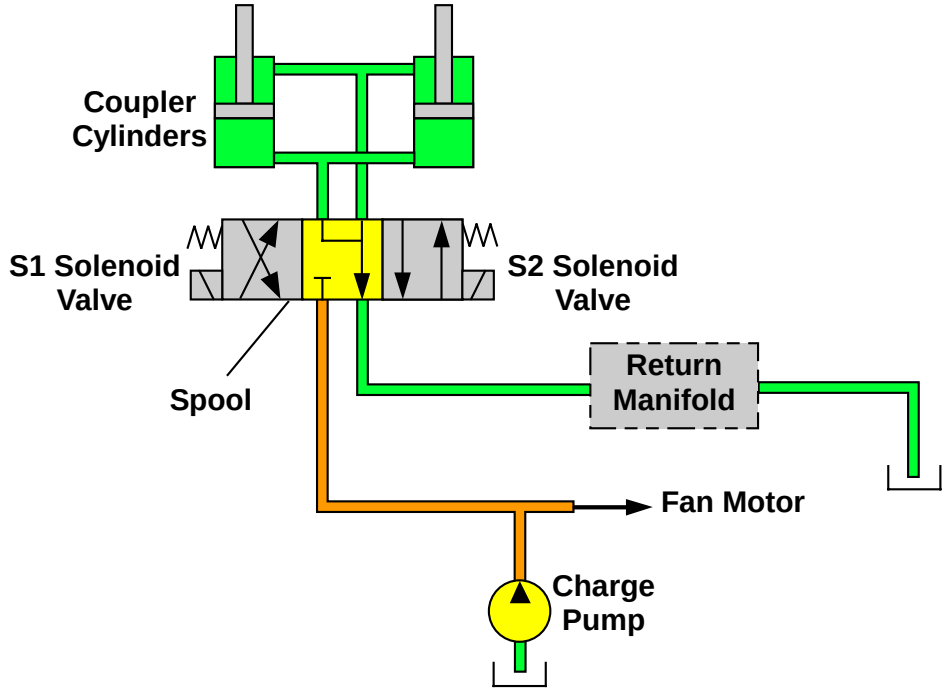


98

The quick coupler valve (arrow) is located behind the fuel filter on the machines equipped with the 3044C Engine.

WORK TOOL COUPLER HYDRAULIC SYSTEM

HOLD

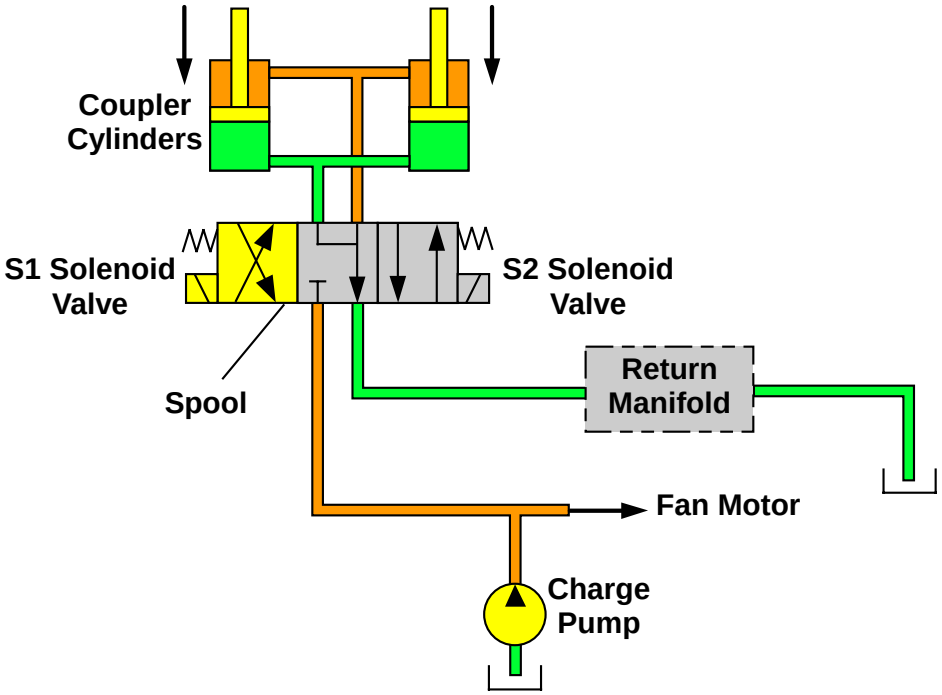


99

Supply oil for the work tool coupler circuit is provided by the charge pump. In the HOLD position, the flow from the charge pump is blocked by the spool. All of the charge pump flow is directed towards the fan motor. The rod end and head end of the coupler cylinders are open to the hydraulic tank.

WORK TOOL COUPLER HYDRAULIC SYSTEM

UNLOCK



100

This illustration shows the work tool coupler hydraulic system in the UNLOCKED position. In the UNLOCK position, the S1 solenoid energizes to shift the spool to the right, allowing charge pump oil to flow to the rod end of the coupler cylinders.

In the LOCKED position, the S2 solenoid valve shifts the spool to the left, allowing charge pump oil to flow to the head end of the coupler cylinders.

101

HIGH FLOW HYDRAULIC SYSTEMS

The high flow hydraulic system is used to operate complex hydraulic work tools that incorporate a hydraulic motor, and in some cases, hydraulic cylinders, for doing specialized, high production jobs. Examples of work tools include: augers, cold planers, tillers, trenchers, and brooms. A PC205 Cold Planer is shown in the illustration. Most complex work tools are available in "standard flow" and "high flow" configurations. High flow work tools are only compatible with high flow machines.

Two types of high flow hydraulics are used on "B" Series Skid Steers and Multi-Terrain Loaders: high performance XPS high flow and high flow. The XPS high flow system is used on the 248B Skid Steer Loader, the 268B Skid Steer Loader, and optional on the 287B Multi-Terrain Loader. A high flow system is available as attachment to the 226B and 242B Skid Steer Loaders and the 257B Multi-Terrain Loader.

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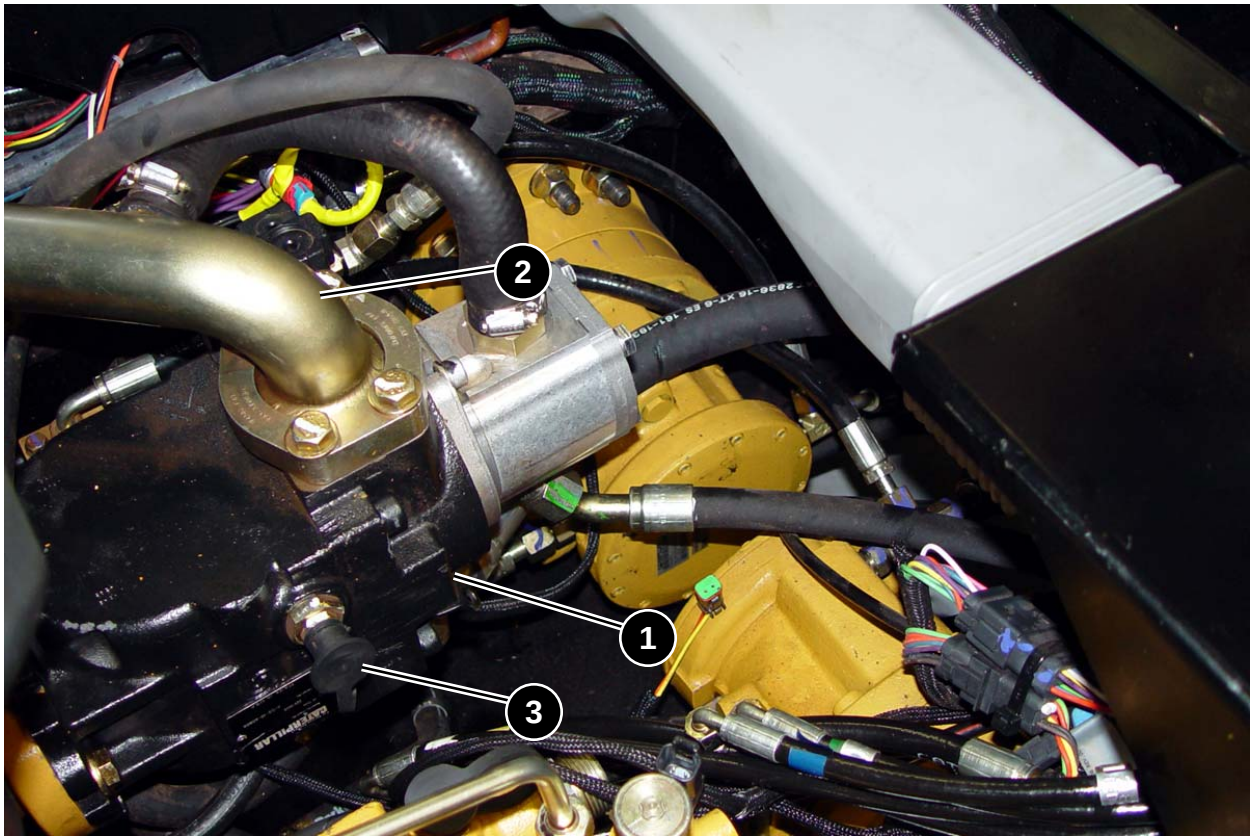
248B/268B High Performance (XPS) High Flow Hydraulic System

This illustration shows a SW45 Wheel Saw attached to a 268B High Flow Skid Steer Loader.

The 248B Skid Steer Loader, the 268B Skid Steer Loader and the 287B Multi-Terrain Loader (when fitted) feature a load sensing, pressure compensated, variable displacement piston pump and closed-center control valves used in a Proportional Priority Pressure Compensated (PPPC) hydraulic system. The PPPC hydraulic system divides the oil flow between each operating circuit in the system. The amount of oil directed to a particular circuit is proportional to the position of the compensator control spool, which is controlled by the load sensing signal rail.

Because the valves are pressure compensated, cylinder speeds will not change as the load varies as long as the pump can meet system flow needs. When the flow demands of the system exceed the total flow available from the pump, the flow is divided proportionally between all activated circuits; however, the work tools will all move slower due to the reduced amount of flow available.



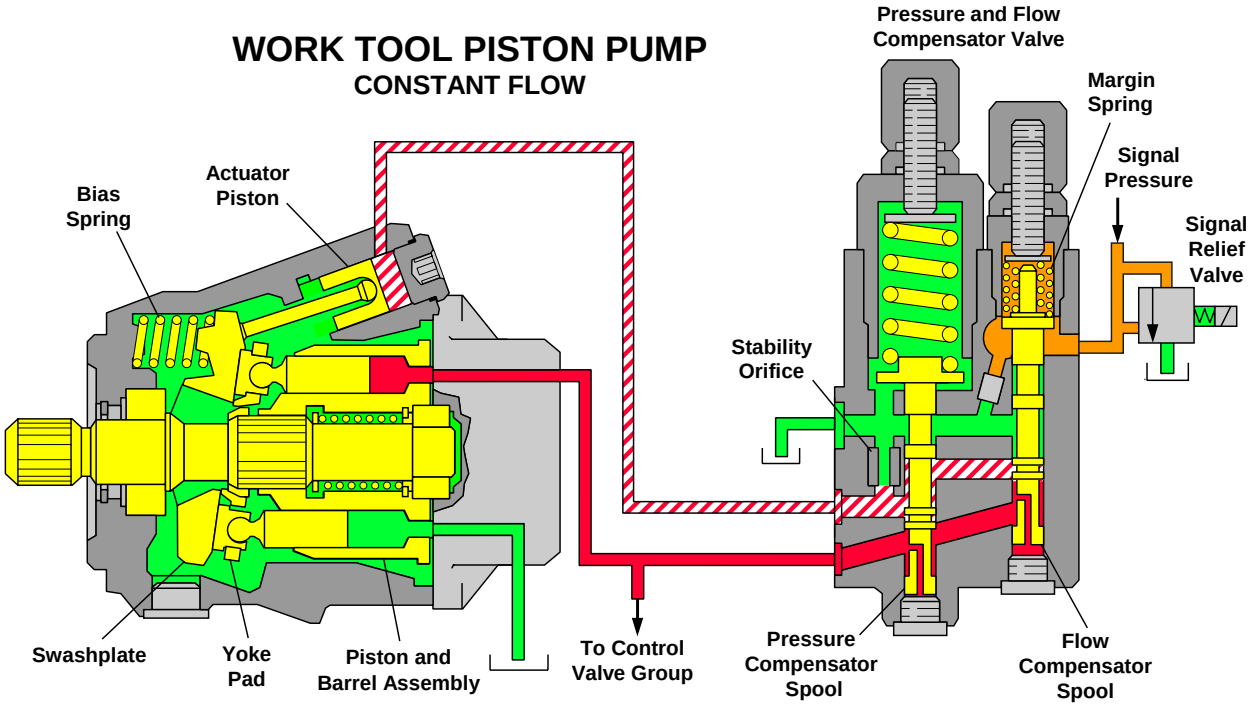
103

The XPS High Flow System uses a load sensing, pressure compensated, variable displacement piston pump (1) that is mounted to the hydrostatic drive pump group.

The work tool piston pump produces an oil flow of 125 L/min (33 gpm).

Hydraulic oil from the tank is drawn into the hydraulic system through the supply hose (2) connected to the front of the work tool piston pump.

The pump control valve components consist of the flow compensator spool (not visible) and the pressure compensator spool (not visible). The pressure tap (3) on the right side of the pump can be used to measure the case pressure.



104

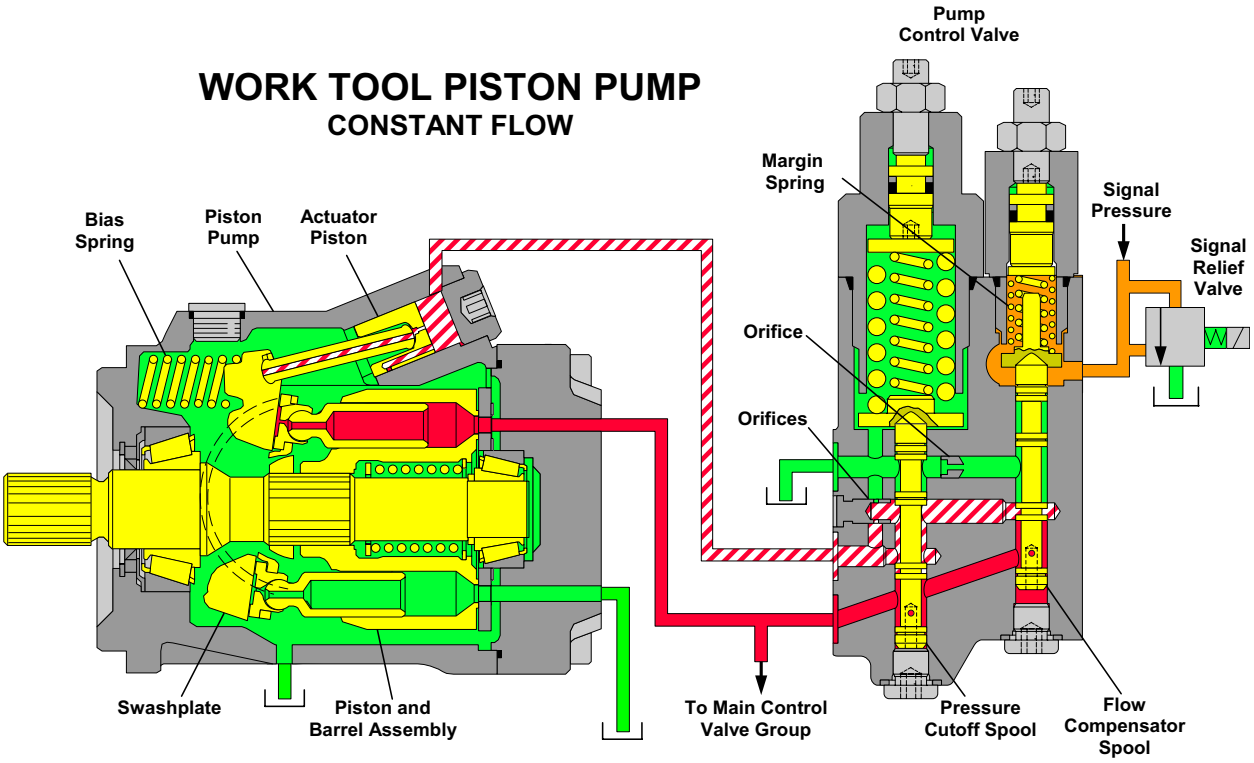
The XPS High Flow System pump is a variable displacement axial piston pump, similar to the variable displacement pumps on other Caterpillar machines. This illustration shows a typical variable displacement axial piston pump.

The signal relief valve in the work tool control valve controls the maximum signal pressure sent to the flow compensator. The large actuator, small actuator, and the bias spring work together to adjust the angle of the swashplate.

The compensator valve controls the flow of oil to the large actuator piston and thereby controls the pump output. Inside the compensator valve are the flow compensator spool and the pressure compensator spool.

The flow compensator maintains the margin pressure between the pump supply pressure and the signal pressure (margin pressure). The margin pressure is adjusted by turning the margin spool adjustment screw. Adjusting margin pressure also changes standby pressure.

The pump pressure compensator controls the maximum system pressure only when the high flow circuit is activated.



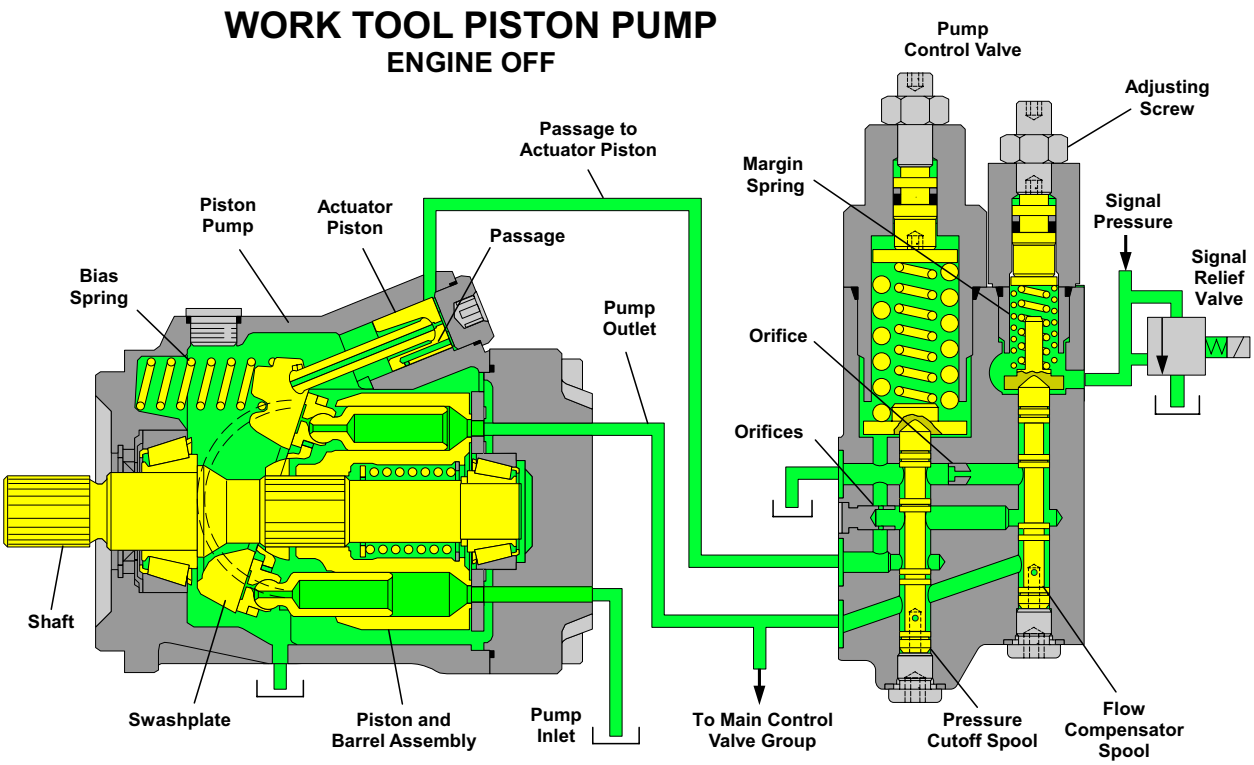
105

The pump control valve contains two spools. The margin spool regulates output flow of the pump to keep the pump supply pressure at a fixed value above the signal pressure. The difference between the supply pressure and signal pressure is called "margin pressure." The pressure cutoff spool limits the maximum system pressure and serves as a back-up relief valve for PPPC hydraulic systems. The signal relief valve and margin spring control the maximum system pressure in most instances.

The pump is designed to maintain flow. Whenever the forces above and below the margin spool are not balanced due to changes in the flow demand, the pump will upstroke or destroke to meet the flow demand.

When the pump supply pressure equals the sum of the signal pressure plus the margin spring value, the margin spool moves to a metering position to control oil to and from the actuator. This action stabilizes the system. The swashplate is held at a relatively constant angle to maintain the required flow. This is called "CONSTANT FLOW."

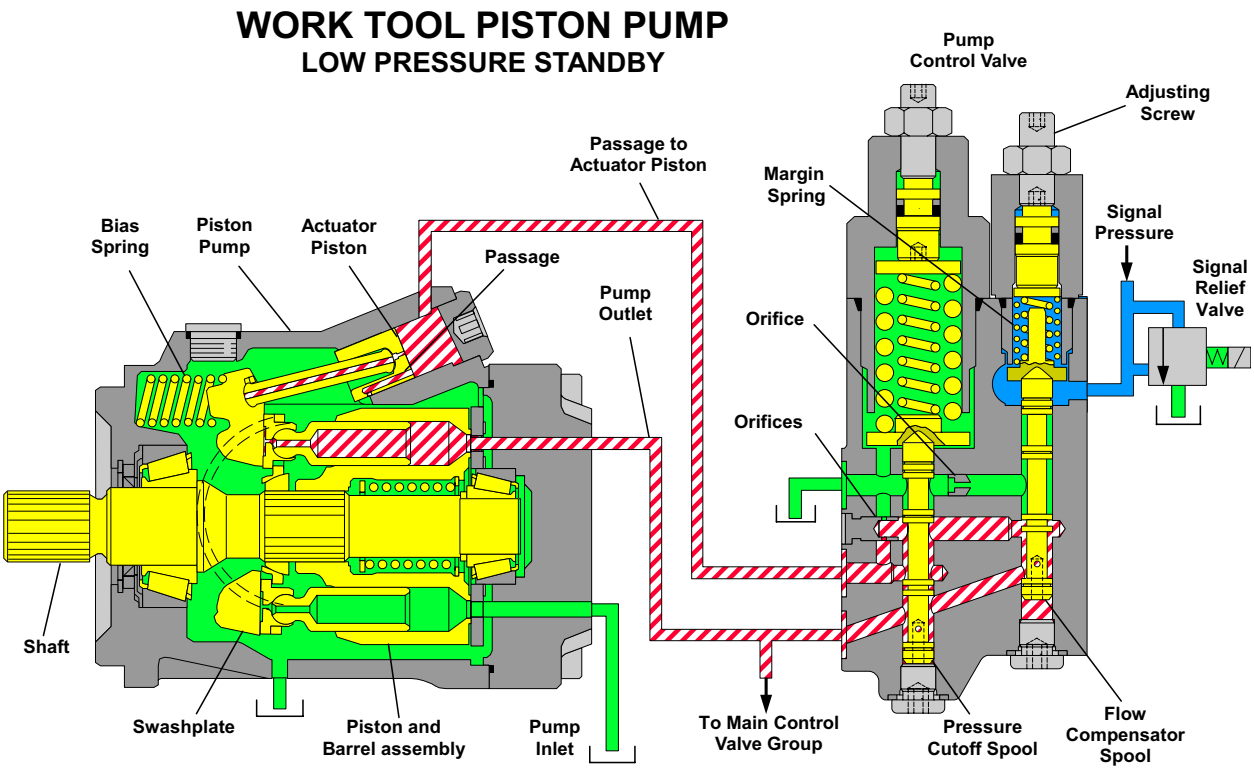
The pump control valve has stability orifices in the passage to the actuator piston. The orifices are used to regulate the response rate of the actuator piston by creating a constant leakage path to drain. The orifice between the two spools controls the upstroking speed of the pump.



106

When the engine is OFF, no signal pressure is sent to the pump control valve. The margin spring holds the margin spool down.

Any pressure behind the actuator piston goes to case drain across the margin spool. With no pressure behind the actuator piston, the bias spring in the pump holds the swashplate at maximum angle.



107

When the engine is started, the pump drive shaft begins rotating. Tank oil is drawn into the piston bore from the pump inlet. As the pistons and barrel assembly rotate, the oil is forced from the pump outlet into the hydraulic system.

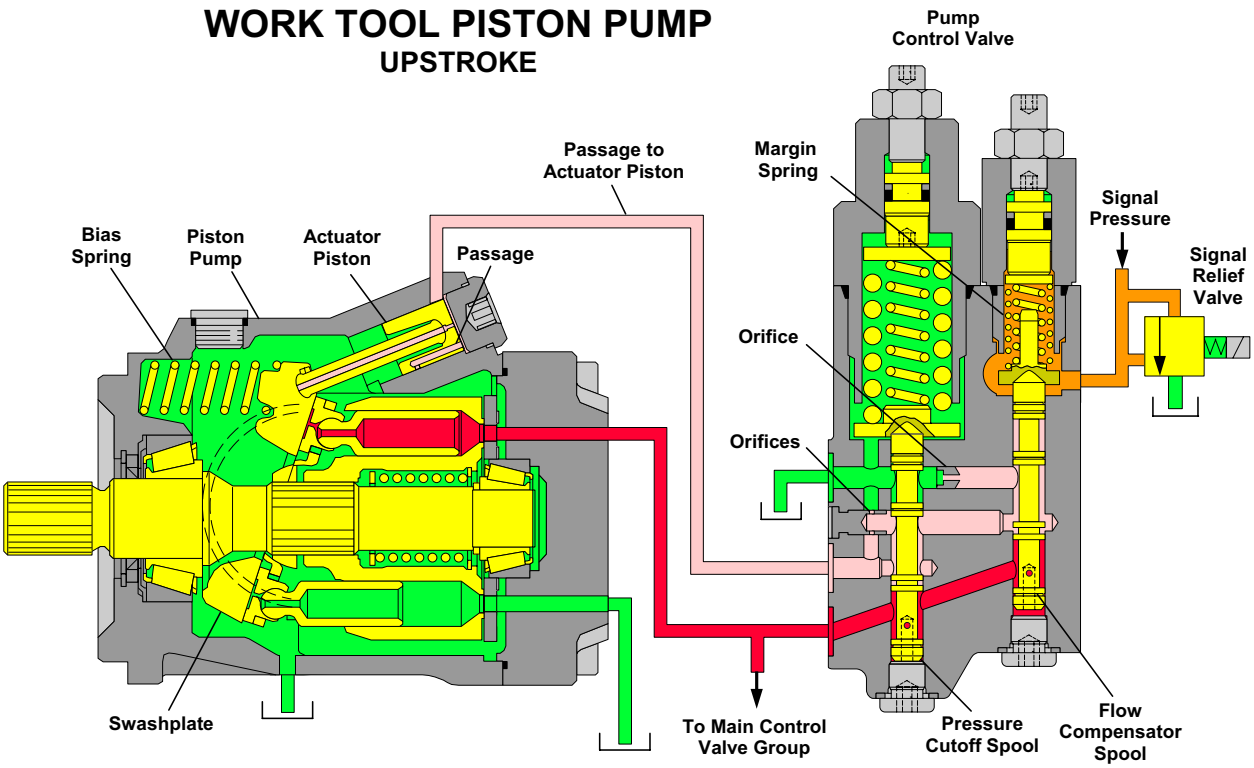
The hydraulic system pressure begins to increase because the flow is blocked at the main control valve group. The increased pressure is felt below the margin spool. The margin spool moves up against the margin spring and permits some system output oil to fill the chamber behind the actuator piston.

The pressure behind the actuator piston increases, overcomes the force of the bias spring, and moves the swashplate to a minimum angle. When the passage in the actuator opens to the pump case, the actuator piston travel stops.

At this minimum angle, the pump produces enough flow to compensate for system leakage and maintain sufficient pressure to provide instantaneous response when a control lever is activated. With no flow demand from a circuit, no signal pressure is generated. The pump output pressure has to overcome only the margin spring value. This condition is called "LOW PRESSURE STANDBY."

In this system, LOW PRESSURE STANDBY is higher than margin pressure. This characteristic is due to a higher back pressure created by the oil which is blocked in the hydraulic system. During LOW PRESSURE STANDBY, the pump output oil pushes the margin spool farther up to compresses the margin spring more. More supply oil now goes to the actuator piston and slightly destrokes the pump.

NOTE: *Depending on the adjustments made to the margin spool and the amount of pump leakage, low pressure standby and margin pressure can be equal. Margin pressure can never be higher than low pressure standby.*



108

The following conditions can result in UPSTROKING the pump:

- a circuit is activated when the system is at LOW PRESSURE STANDBY;

- an additional circuit is activated;

- a control lever is moved for additional flow; or

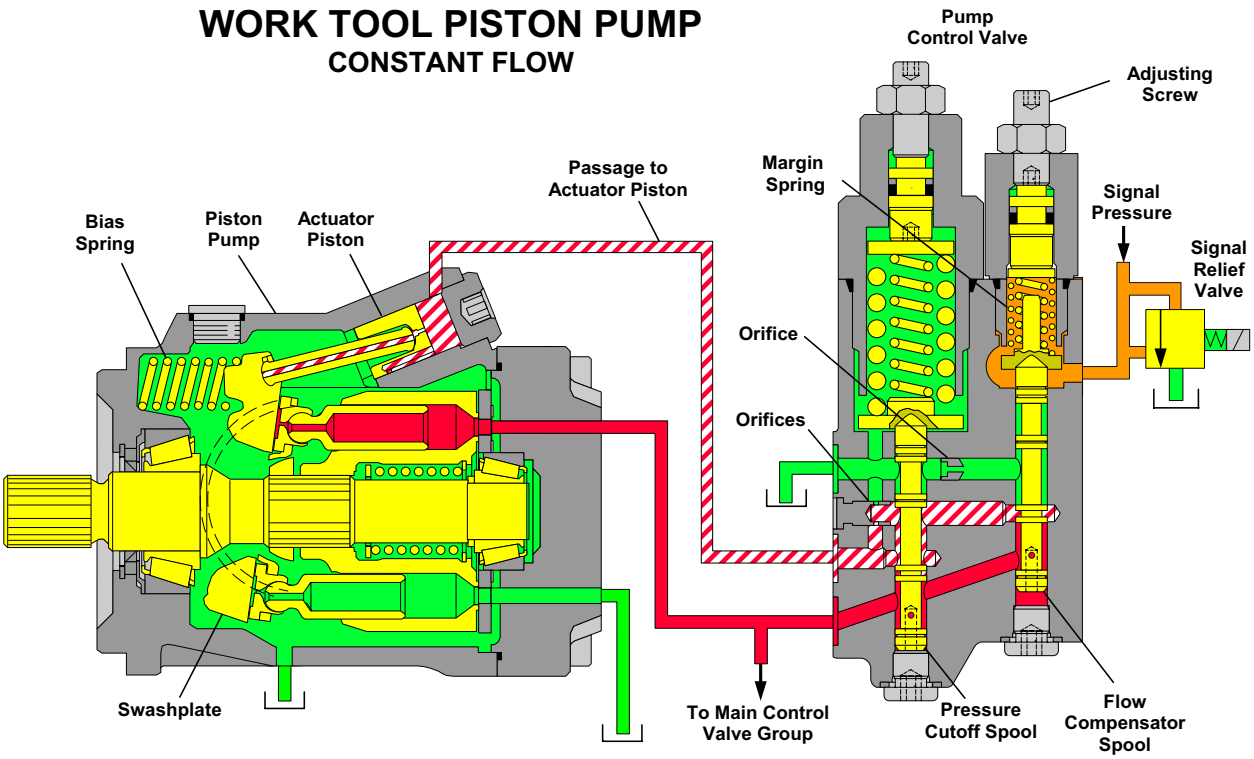
- engine rpm decreases.

When a circuit is activated from LOW PRESSURE STANDBY, the signal pressure plus the margin spring force above the margin spool becomes greater than the pump output pressure below the spool.

The greater force (margin spring plus signal pressure) moves the spool down, blocking the flow of oil to the actuator piston. The oil behind the actuator piston is vented to case drain across the margin spool. The orifice controls the upstroking speed of the pump.

The pressure behind the actuator piston is reduced or eliminated which allows the bias spring to move the swashplate to an increased angle. The pump will now produce more flow. This condition is called "UPSTROKING."

The signal does not have to increase for the pump to upstroke. An increase in flow demand is what causes the pump to upstroke. If the pump output pressure below the spool becomes less than the signal pressure and margin spring force above the spool due to activation of another circuit or reduced engine rpm, the pump will also UPSTROKE.

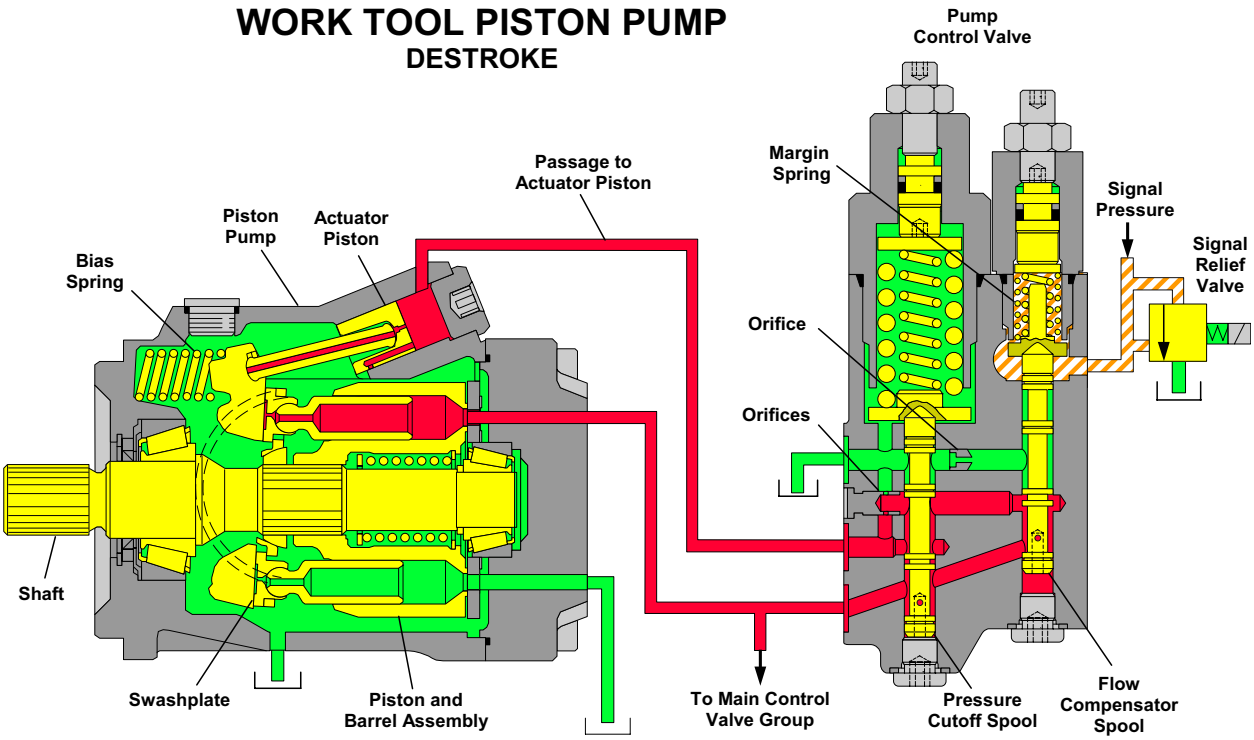


109

As the pump output flow increases (upstroke condition) or decreases (destroke condition) to meet the system demand, the forces acting above and below the margin spool will equalize and the margin spool will move to a metering position. The system stabilizes. The swashplate is held at a relatively constant angle to maintain the required flow.

The difference between the signal pressure and the pump supply pressure is "margin pressure." Margin pressure is the value of the margin spring.

The margin pressure and standby pressure are adjusted by turning the margin spool adjustment screw.



110

The following conditions can result in destroking the pump:

- all the control levers are moved to the HOLD position and the pump returns to LOW PRESSURE STANDBY;

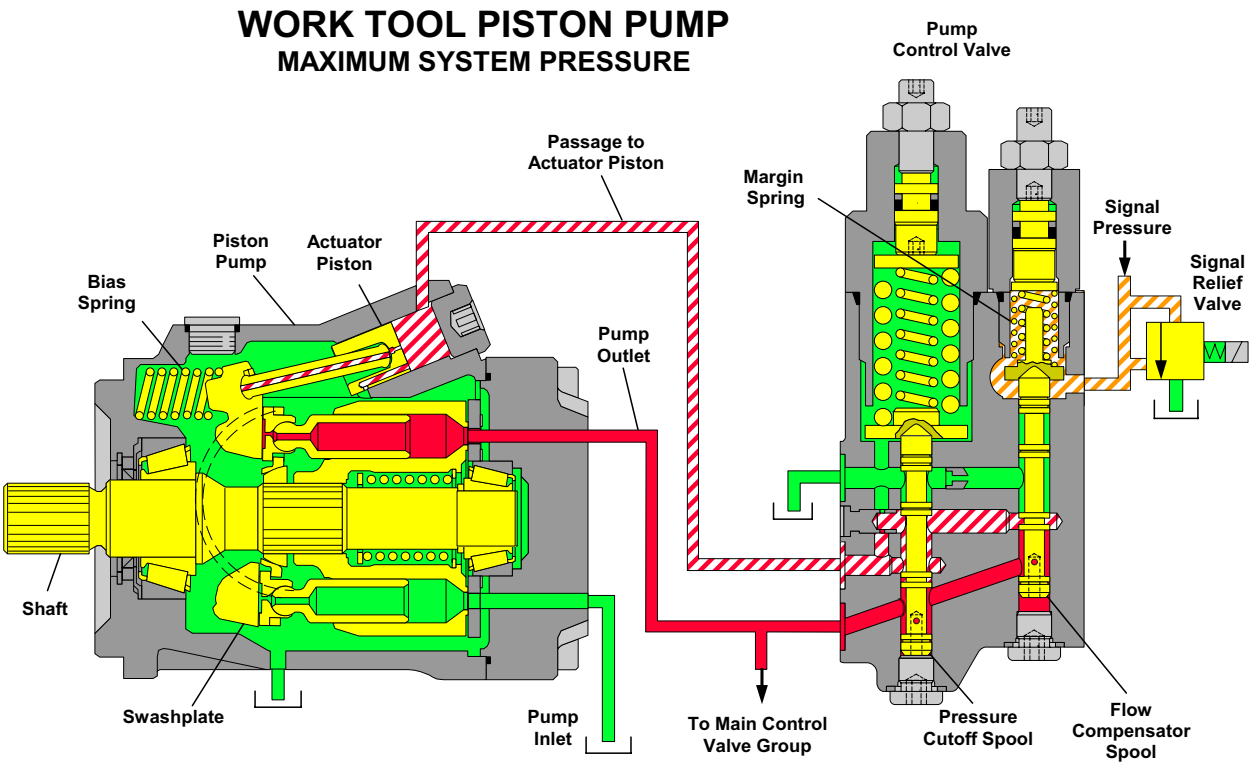
- a control lever is moved to reduce flow;

- an additional circuit is deactivated; or

- engine rpm increases.

When less flow is needed, the pump destrokes. The pump destrokes when the force below the margin spool becomes greater than the force above the spool. The margin spool moves up and allows more output pressure oil to the actuator piston.

Pressure behind the actuator piston increases. The increased pressure overcomes the force of the bias spring and moves the swashplate to a reduced angle. When the new pump output pressure matches the force below the margin spool, the spool returns to a metering position. The pump



111

The signal limiter valve limits the maximum load sensing signal pressure. The signal limiter valve works with the margin spring to control the maximum system pressure.

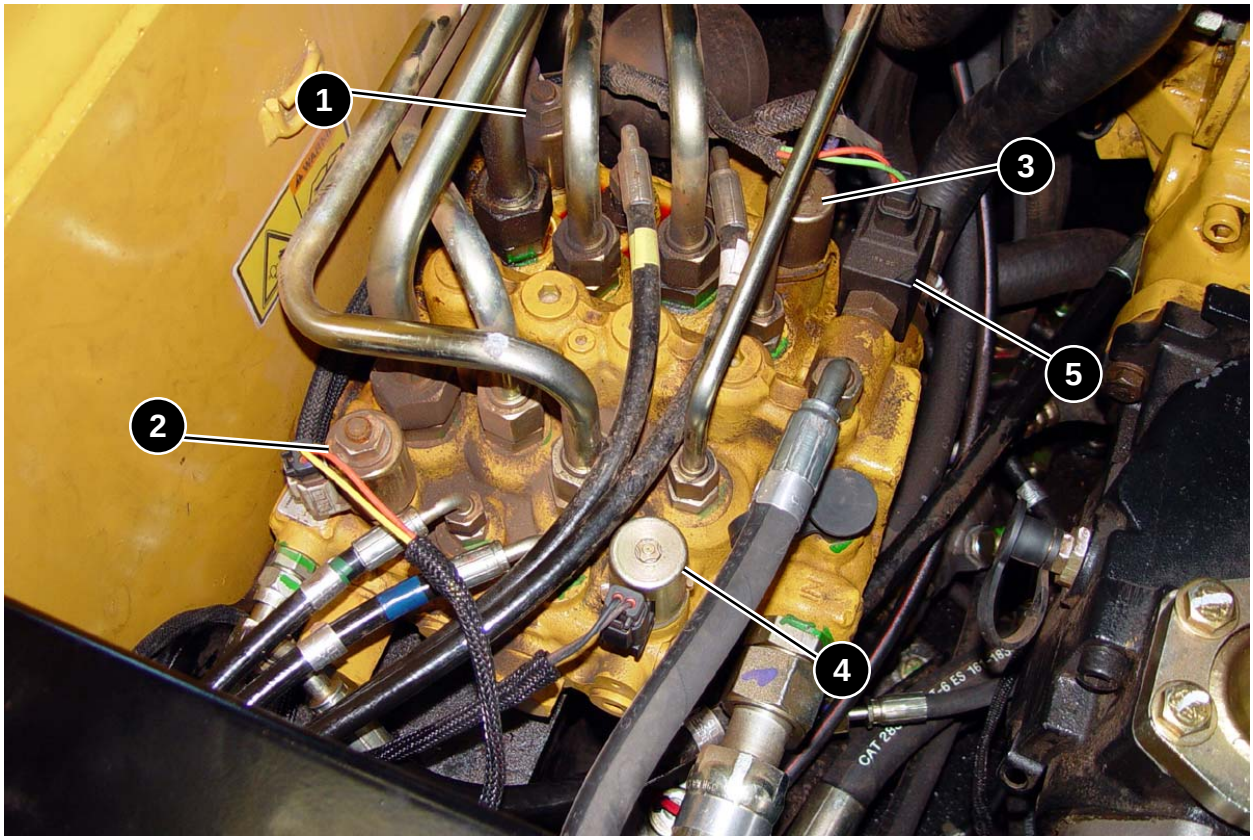
The pressure cutoff serves as a backup to the signal limiter and margin spring. The pressure cutoff is set above the combined spring settings of the signal limiter and the margin spring.

When a circuit is stalled, the signal limiter opens to limit the maximum system pressure.

Initially, the combined forces of the signal pressure and margin spring are less than pump output pressure. The supply pressure moves the margin spool up to destroke the pump. Once the pump destrokes to provide very little flow at a high pressure, the margin spool moves to a metering position to maintain the desired minimum flow rate. In the metering position the margin spring and the signal limiter equal the pump output pressure.

If a second circuit is activated while another circuit is stalled, the pump will upstroke to meet the new flow requirements.

NOTE: *Without a signal limiter valve in a PPPC system, if a single circuit is stalled, no*

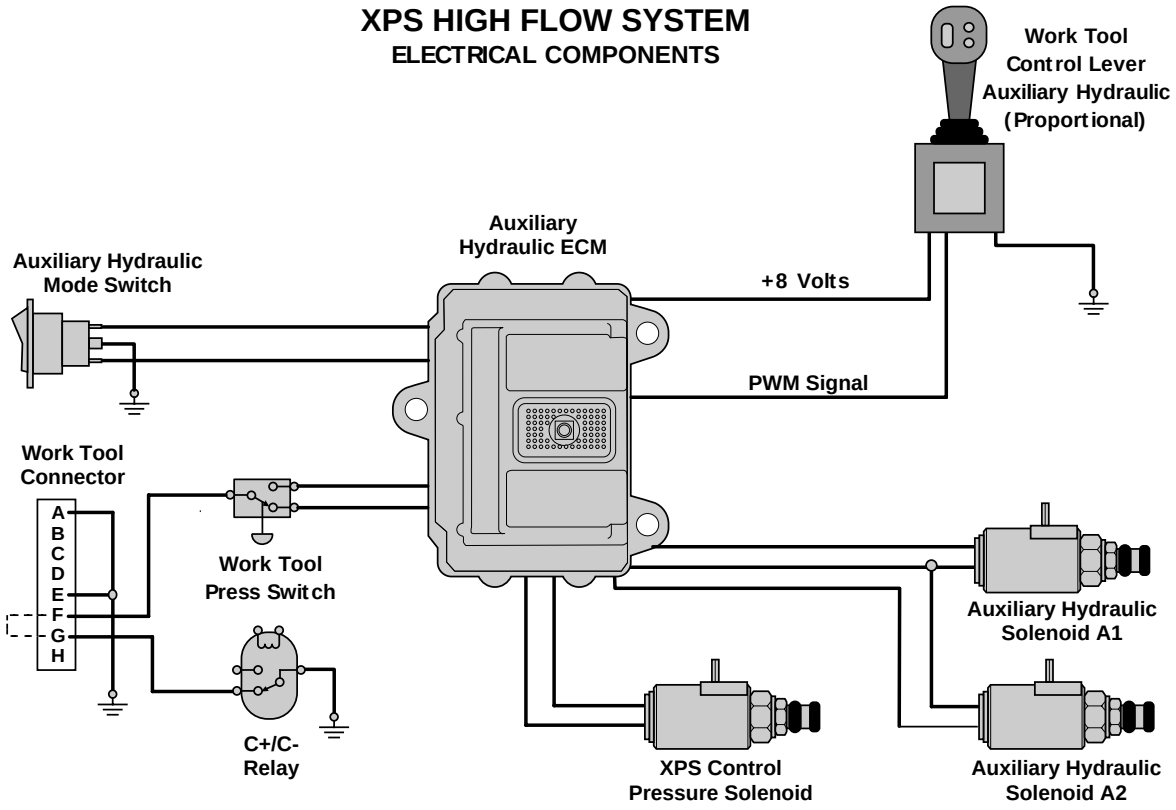


112

The "A1" solenoid (1) and "A2" solenoid (2) provide pilot oil to shift the control spool for the auxiliary and high flow functions. These solenoids are proportionally controlled by the Auxiliary Hydraulic ECM.

The "C+" solenoid (3) and "C-" solenoid (4) provide pilot oil to shift the control spool for suppling oil to the control flow lines on the work tool lift arm. These solenoids are ON/OFF controlled by switches on the work tool joystick.

A dual stage load sensing relief valve (5) is used to maintain system pressure. The system pressure is increased during high flow operation via the solenoid.



113

This illustration shows the input and output components used by the Auxiliary Hydraulic ECM for the XPS High Flow Hydraulic System.

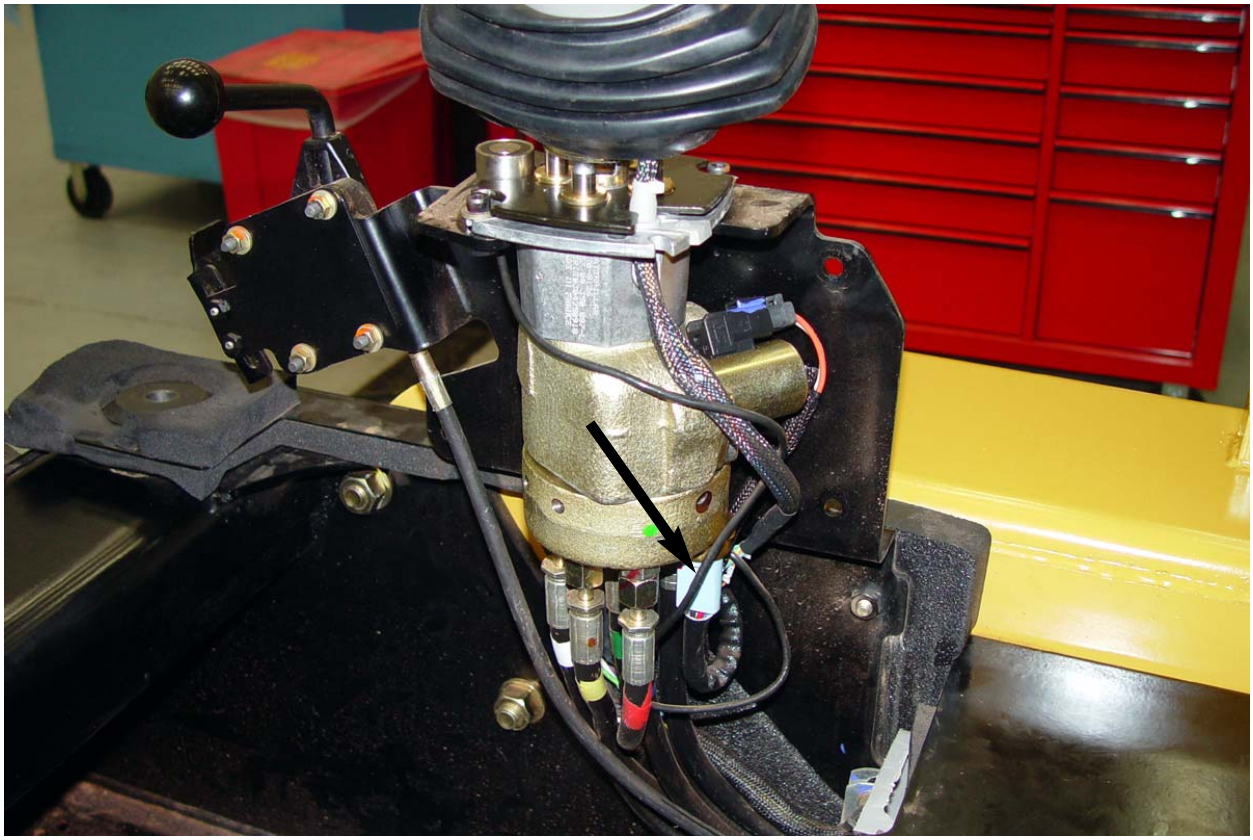
The Auxiliary Hydraulic ECM monitors the position of the auxiliary hydraulic mode switch. When the switch is in the High Flow mode and the auxiliary control is at or near its maximum output, higher current is sent to the auxiliary hydraulic solenoid. This will allow more hydraulic oil flow to the auxiliary hydraulic circuit.

If a highflow work tool is detected and the C+/C- functions or the work tool pressure switch are not activated, the Auxiliary Hydraulic ECM will activate the XPS control pressure solenoid. The solenoid will compress the spring in the load sensing relief valve. The relief valve will then generate higher signal pressures resulting in higher system pressures.

114

The XPS high flow hydraulic system uses the proportional control (1) on the work tool lever shown in this illustration. The sliding switch (1) on the left side of the lever is used to control the proportional auxiliary hydraulic and high flow circuits (A1 and A2). The flow from the auxiliary/high flow circuit is proportional to the movement of the switch.

The switches on the right side of the joystick are used to operate the work tool control circuit, "C+" and "C-". Depress the top switch (2) to activate the "C+" function. Depress the bottom switch (3) to activate the "C-" function. The switches energize relays that in turn energize the C+ or C- solenoid. The Auxiliary Hydraulic ECM monitors the "C+/C-" relay. If High Flow Mode is selected, the ECM will disable the XPS pressure solenoid when the "C+/C-" relay is activated.

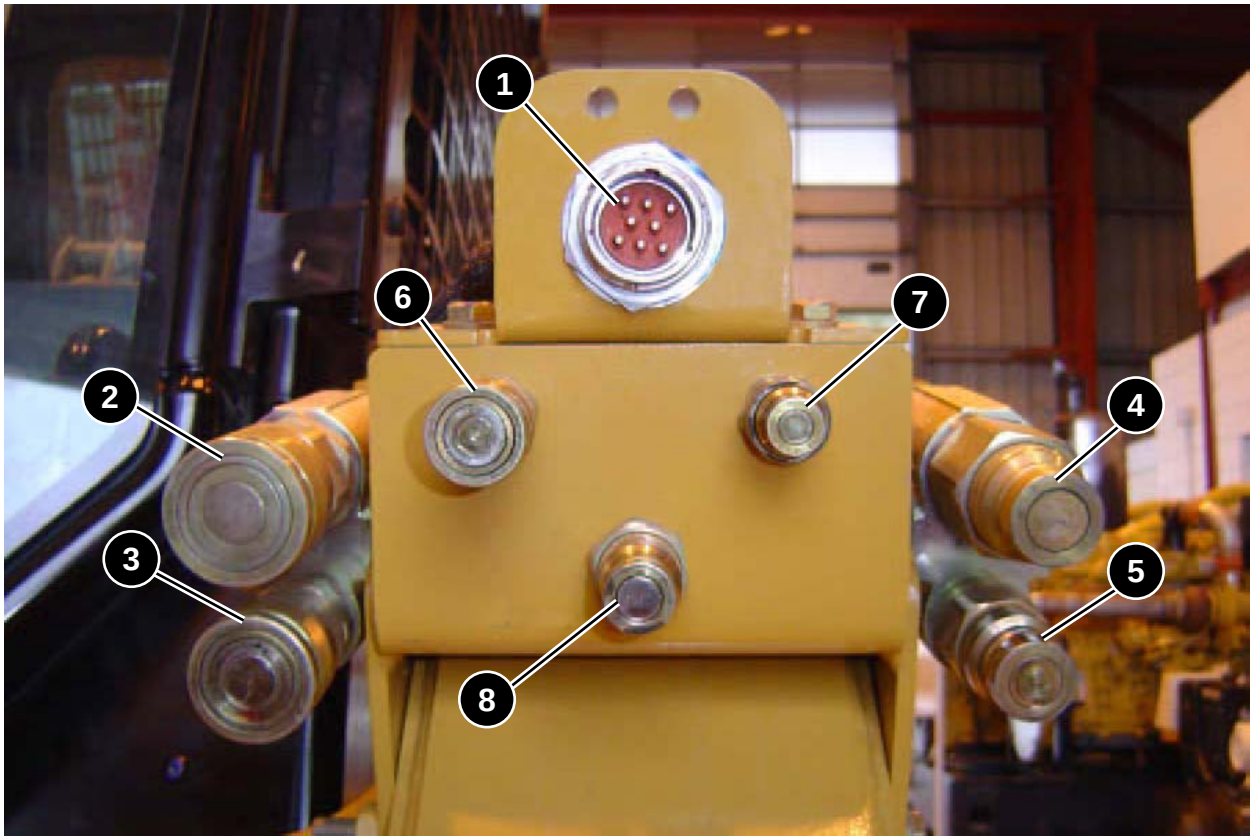


115

The work tool pressure switch located below the work tool pilot valves closes to signal the Auxiliary Hydraulic ECM when the joystick is used to request a lift or tilt function. If High Flow Mode is selected, the ECM will disable the load sensing relief valve solenoid when the pressure switch is closed.

116

The operator can choose either "standard flow" or "high flow." Depress the left side of the auxiliary hydraulic mode switch (arrow) on the left console to enable the high flow function.



117

An electrical connector (1) provides electrical power to a three-position diverter valve located on some work tools.

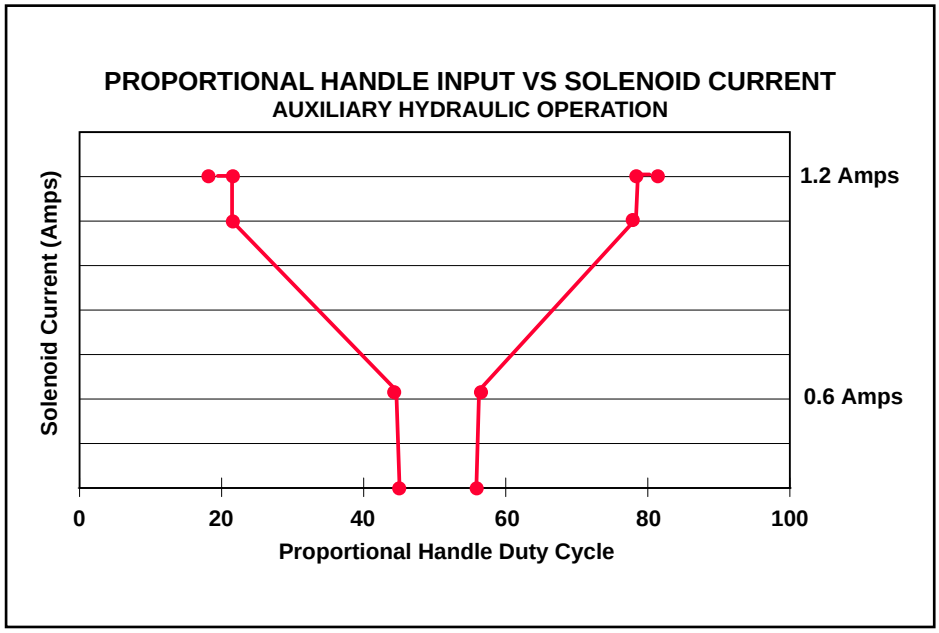
The work tool auxiliary hydraulic lines and electrical connector are located on the left lift arm of the machine. The auxiliary hydraulic lines allow oil flow to and from the work tools. The lines are equipped with quick disconnects.

The top left quick disconnect (2) supplies oil for high flow work tools when the "A2" control is activated. The bottom left quick disconnect (3) supplies oil for standard work tools when the "A2" control is activated.

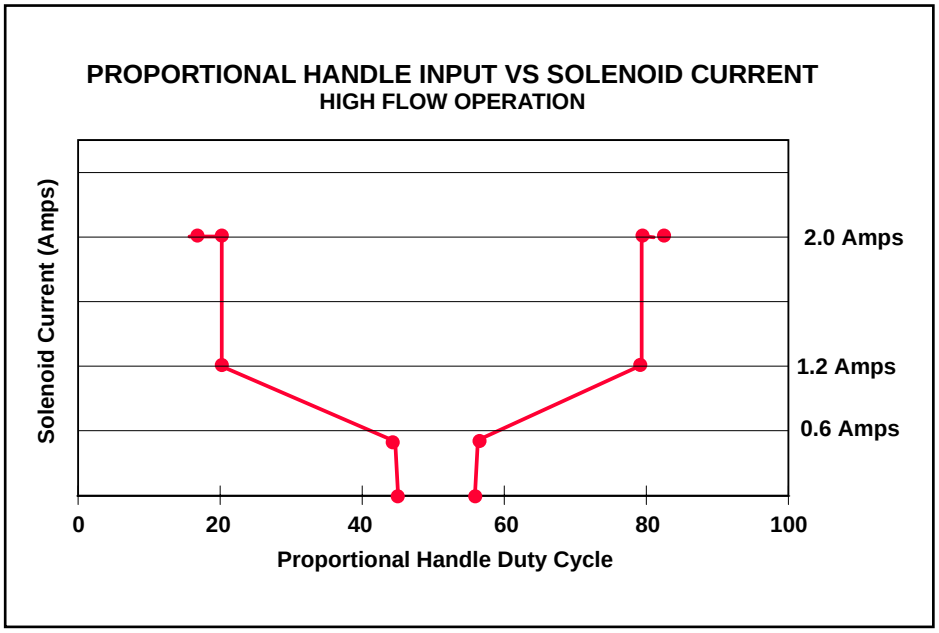
The top right quick disconnect (4) supplies oil for high flow work tools when the "A1" control is activated. The bottom right quick disconnect (5) supplies oil for standard work tools when the "A1" control is activated.

The left center quick disconnect (6) supplies oil for the control circuit on some work tools when the "C-" control is activated. The right center quick disconnect (7) supplies oil for the control circuit on some work tools when the "C+" control is activated.

The center quick disconnect (8) is a return line to tank.



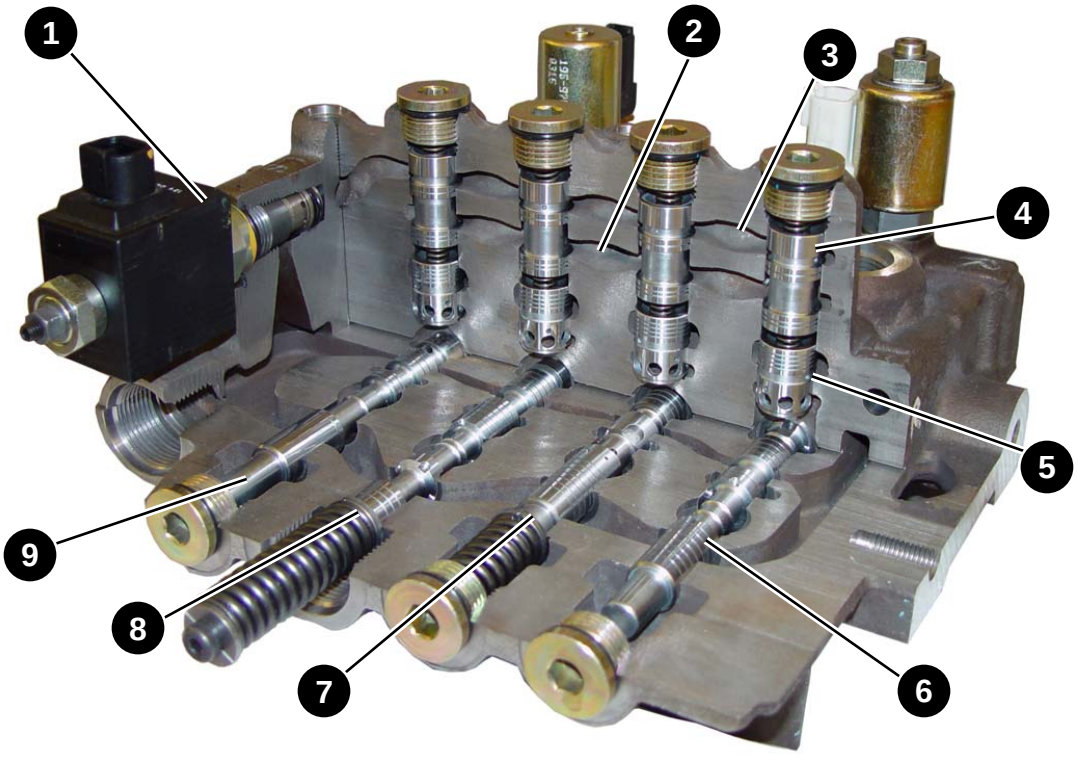
118



119

The top illustration shows the current directed to the auxiliary solenoids by the Auxiliary Hydraulic ECM when the standard flow option is active. When the duty cycle from the joystick is 50 ± 5%, the Auxiliary Hydraulic ECM directs no current to either solenoid. When the operator actuates the auxiliary control, the duty cycle changes. The Auxiliary Hydraulic ECM varies the current to a maximum of 1.2 Amps when the standard flow option is active.

The bottom illustration shows the current directed to the auxiliary solenoids by the Auxiliary Hydraulic ECM when the high flow option is active. The Auxiliary Hydraulic ECM increases the maximum current to the solenoids from 1.2 Amps to 2.0 Amps when the duty cycle from the joystick is below 20% or above 80%.



120

This illustration shows a cutaway of the high performance high flow control valve group used on the 248B and 268B Skid Steer Loaders. The closed-center valve group features four control spools, pressure compensators, signal duplication valves, and a load sensing relief valve.

Load sensing relief valve (1) – The load sensing relief valve controls the maximum signal pressure that is directed to the pump controls. A solenoid adjusts the setting of the load sensing relief valve at one of two settings as determined by the Auxiliary Hydraulic ECM. The Auxiliary Hydraulic ECM adjusts the load sensing relief valve to a setting that is higher than the pump controls when the lift or tilt functions are not activated. The Auxiliary Hydraulic ECM lowers the load sensing relief valve setting to 21000 kPa (3050 psi) when pilot oil from the lift or tilt function closes the pressure switch on the work tool pilot valve and the high flow function is activated. The Auxiliary Hydraulic ECM also lowers the load sensing relief valve setting to 21000 kPa (3050 psi) when the C+ or the C- function is activated and the high flow function is activated.

The load sensing relief valve incorporates a signal drain valve which drains a constant .5 lpm (.13 US gpm) from the load sensing signal circuit when a circuit is active.

Auxiliary pump supply rail (2) – The pump supply pressure oil is fed through an internal passage to the auxiliary pump supply rail where the pump supply oil is made available to the signal duplication valves.

Load sensing signal rail (3) – The load sensing signal rail contains a pressure equal to the highest work port pressure. The load sensing signal is generated by the signal duplication valves metering oil from the auxiliary pump supply rail.

Signal duplication valves (4) – The four signal duplication valves copy the highest work port pressure by metering oil from the auxiliary pump supply rail to the load sensing signal rail.

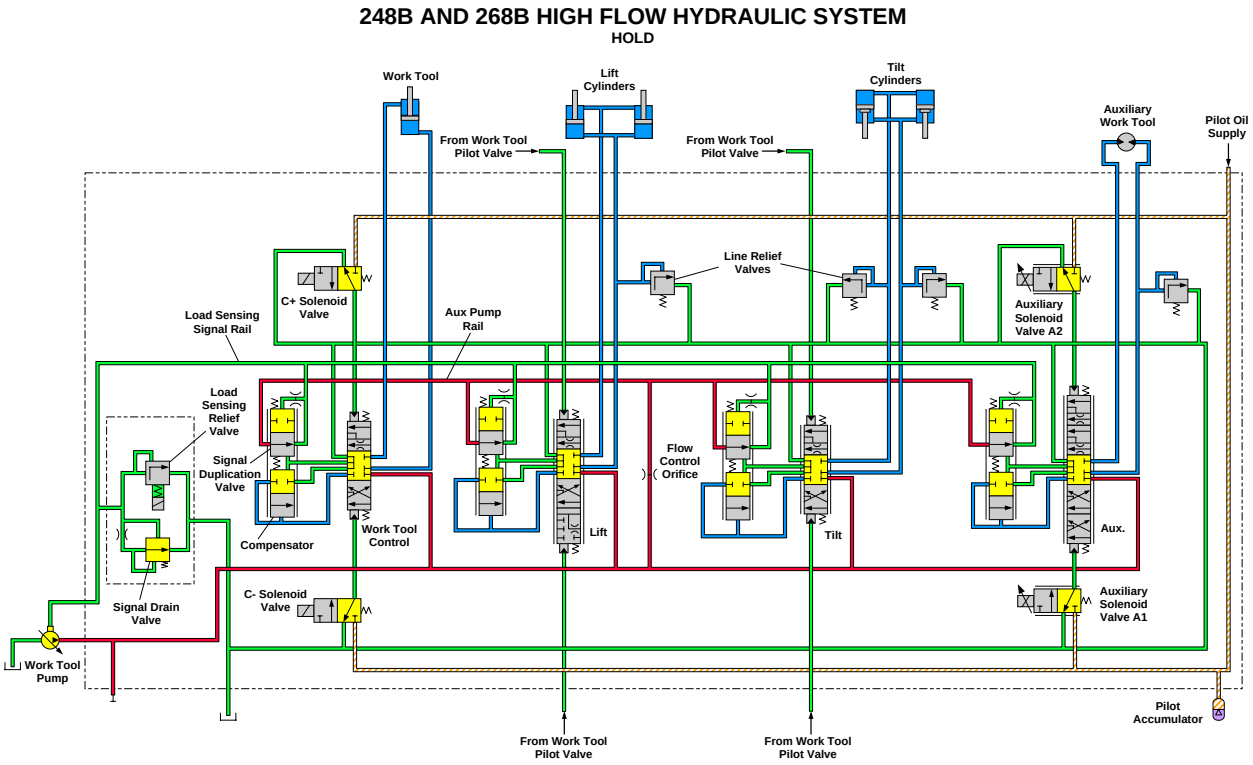
Compensator valves (5) – Oil flow must pass through the compensator valve before flowing to the work tool. When pump capacity is exceeded the four compensator valves use the load sensing signal to proportionately reduce the flow to all activated circuits.

Auxiliary/high flow control spool (6) – The solenoid-operated auxiliary/high flow control spool controls the flow to the auxiliary circuit.

Tilt control spool (7) – The tilt control spool controls the oil flow to the tilt cylinders.

Lift control spool (8) – The lift control spool controls the oil flow to the lift cylinders.

Work tool control spool (9) – The work tool control spool controls the work tool control circuit, "C+" and "C-."

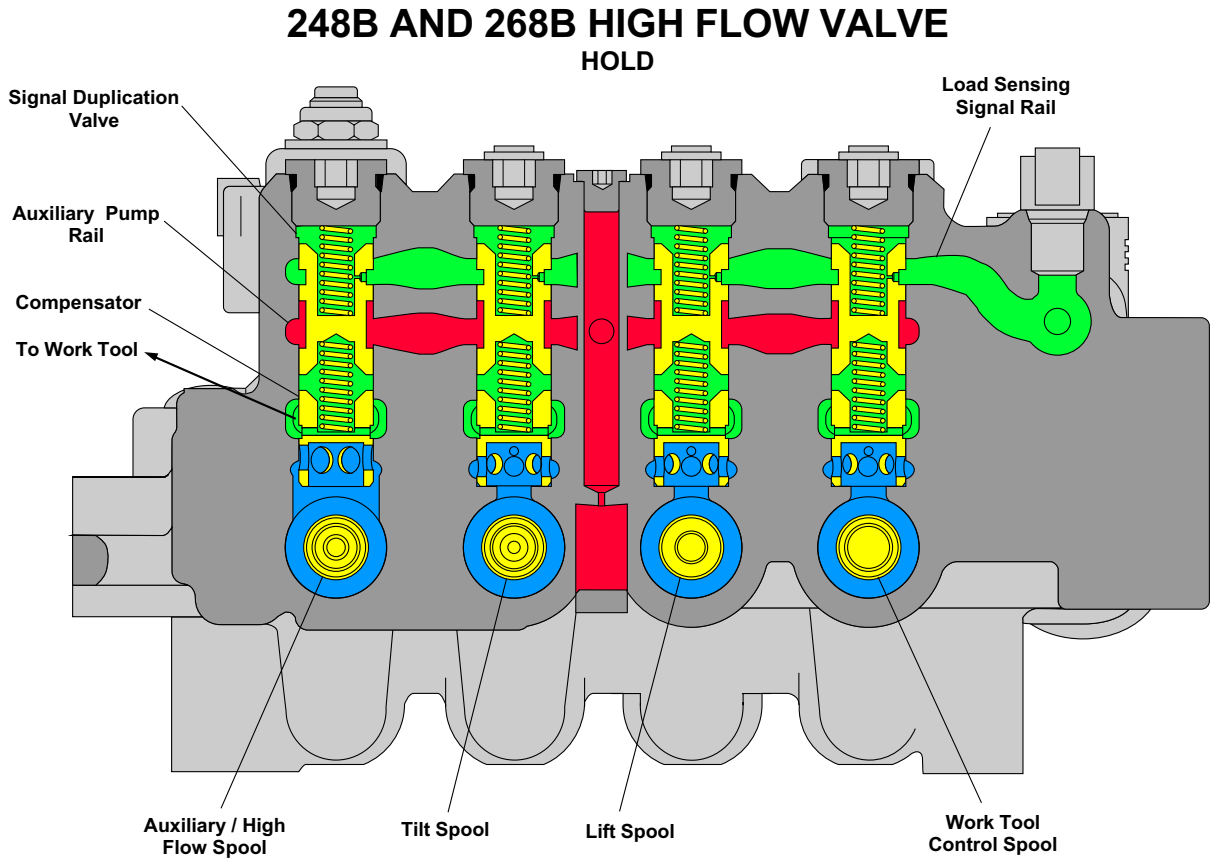


121

This illustration shows the 248B and 268B work tool hydraulic system in the HOLD position with the engine running. Supply oil from the work tool pump flows to each control spool and through the orifice into auxiliary pump rail. A signal drain valve drains the oil from the load sensing signal rail to tank, when the hydraulic system is in the HOLD position.

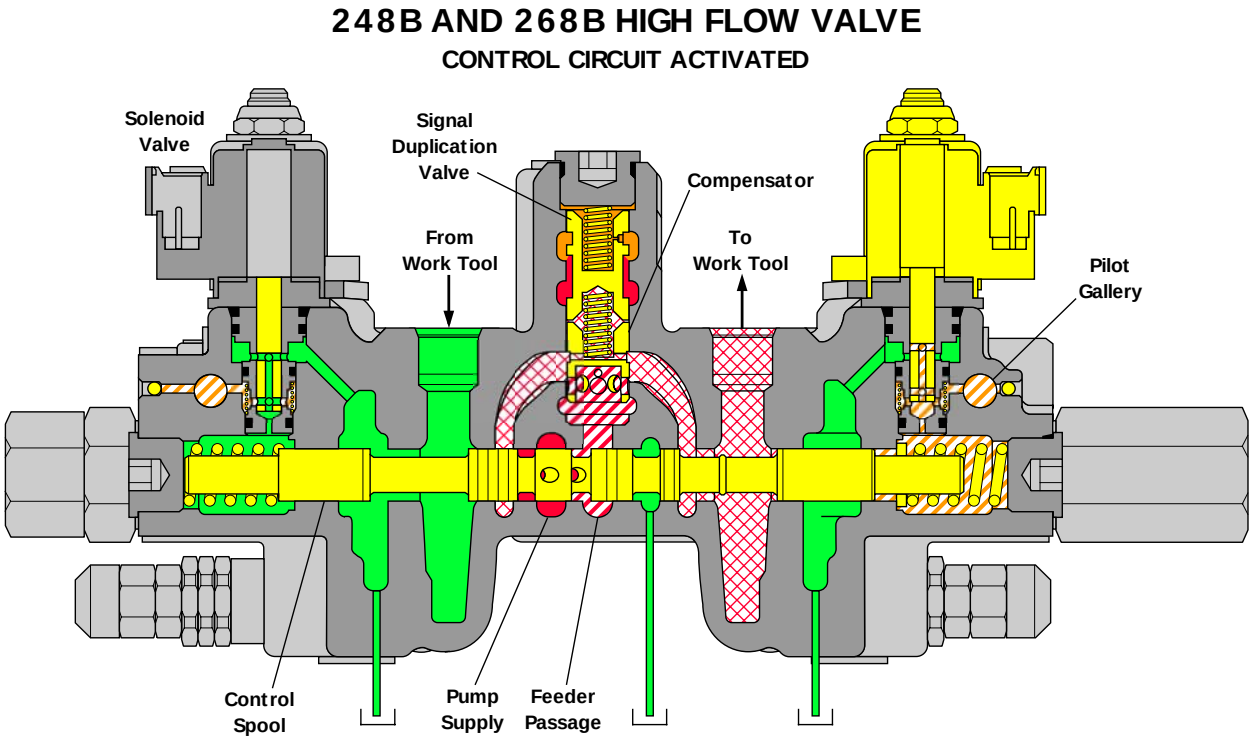
The closed-center work tool spools are in parallel with regard to supply oil. Pump supply is blocked by each spool. With pump supply blocked, all of the compensators are closed. Tank pressure is sensed by the signal duplication valve.

The load sensing relief valve is not energized when all of the spools are in the HOLD position.



122

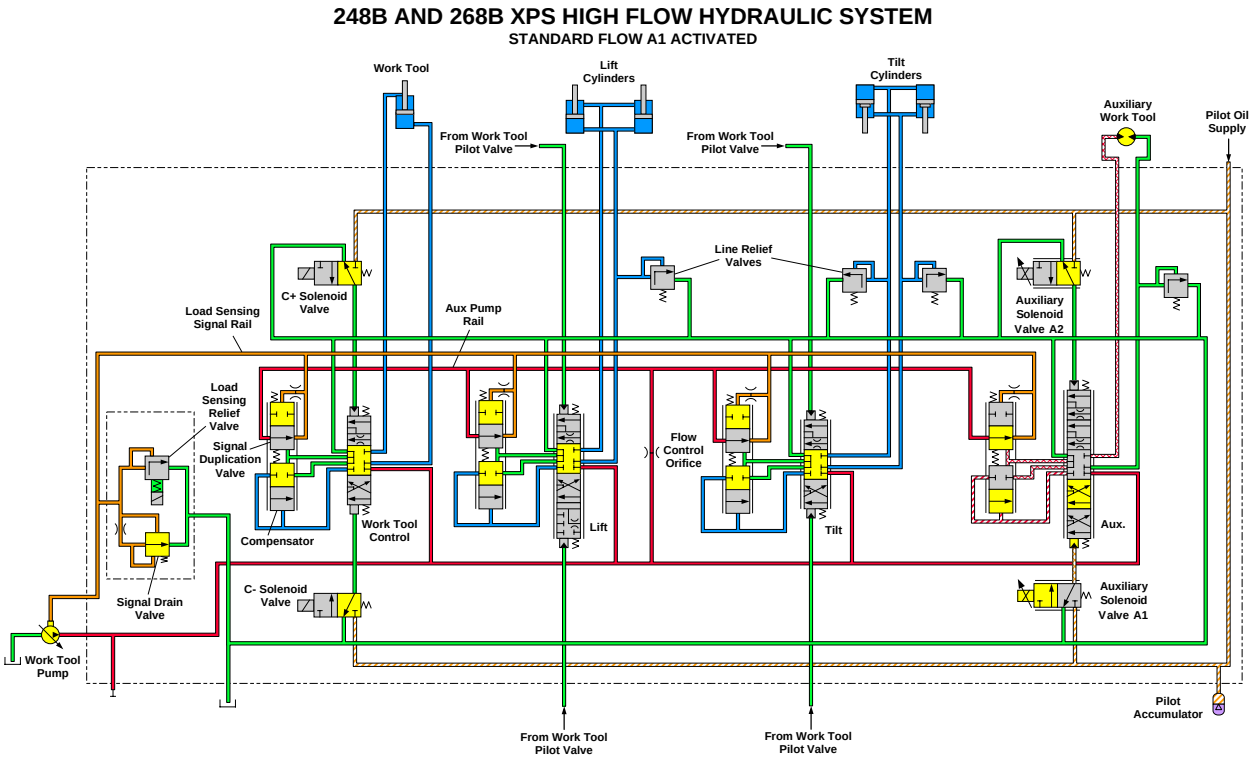
This illustration shows a cutaway of the components of the load sensing signal network. The compensators are seated when the control spools are in the HOLD position. The signal duplication valves are located in their neutral positions.



123

This illustration shows a cutaway view of the components for the work tool control circuit. Pilot oil flows to one end of the control spool when the solenoid is energized. The pilot oil causes the control spool to shift to the left. Oil flows from the pump supply passage to the feeder passage when the control spool shifts. Pressure builds in the feeder passage, causing the compensator to shift upward.

The pump supply oil flows through the compensator, back across the control spool to the work tool. Some of the oil flowing to the work tool flows through a passage in the compensator into the spring chamber above the compensator, causing the pressure in the spring chamber to equal the pressure of the oil flowing to the work tool. The pressure in the spring chamber above the compensator is felt at the bottom of the signal duplication valve. If this is the only active circuit or this circuit has a work port pressure greater than the other active circuits, the signal duplication valve will shift upward. The upward movement of the signal duplication valve allows auxiliary pump supply oil to flow into the load sensing signal passage. Auxiliary pump supply oil flows into the load sensing signal passage until the pressure in the load sensing signal passage is equal to the work port pressure below the signal duplication valve. When the pressures are equal, the signal duplication valve shifts downward to a metering position.

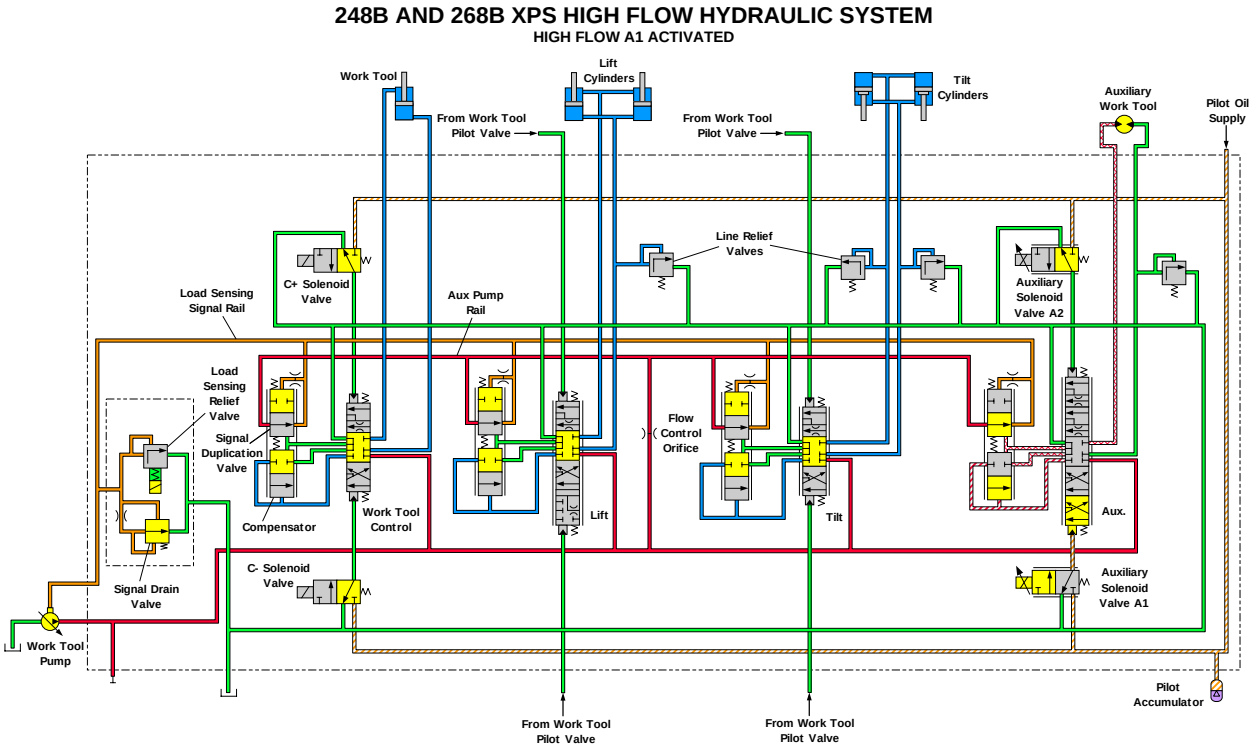


124

This illustration shows the control valve with the "standard flow" A1 auxiliary circuit activated. The solenoid valve directs pilot oil to shift the auxiliary/high flow control spool.

As the spool shifts, pump supply oil flows across the spool to the compensator valve. The compensator shifts upward and allows oil to flow back across the control spool to the work tool.

Some of the oil flowing past the compensator flows into the chamber between the compensator and the signal duplication valve. With no other circuits activated, the pressure in the load sensing signal rail is at tank pressure. The pressure below the signal duplication valve is greater than the pressure of the load sensing signal rail; therefore, the signal duplication valve moves upward. As the signal duplication valve moves upward, oil from the auxiliary pump rail flows into the load sensing signal rail until the pressure in the load sensing signal equals the work port pressure below the signal duplication valve.



125

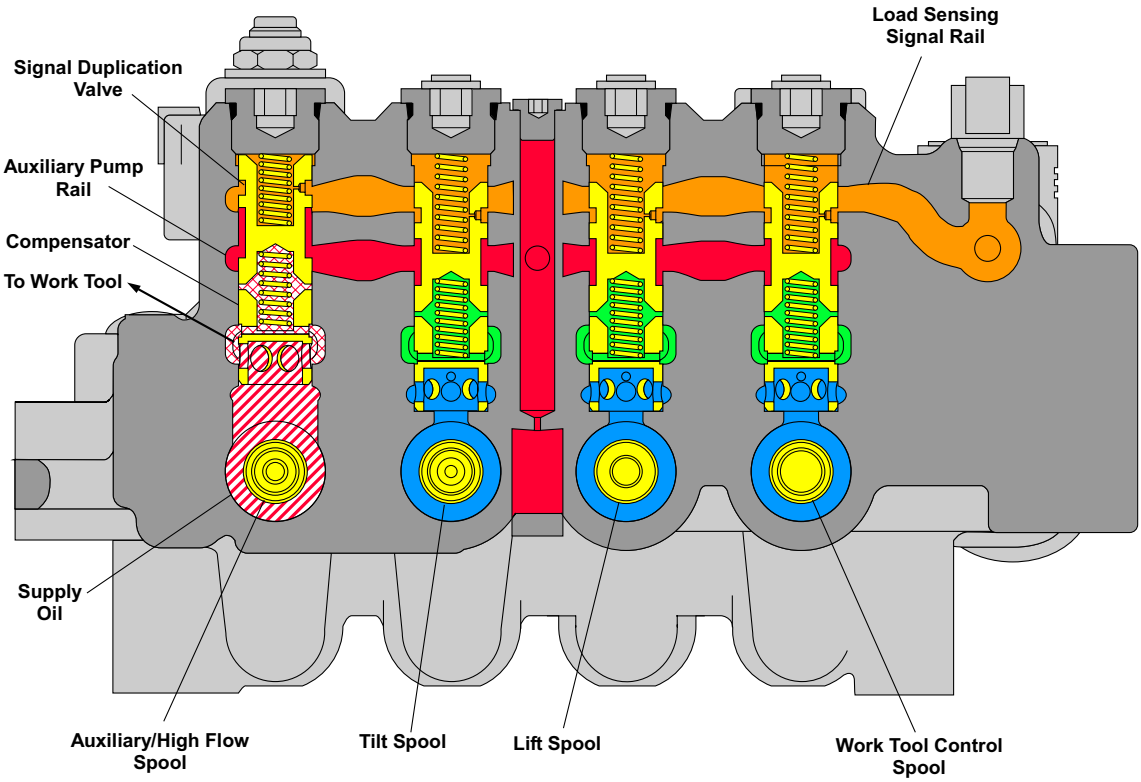
This illustration shows a control valve with only the "high flow" A1 circuit activated. The high flow circuit functions similar to the "standard flow" circuit, except that the Auxiliary Hydraulic ECM directs more current to the solenoid valve, allowing the control spool to shift farther.

When only the high flow circuit is active, the Auxiliary Hydraulic ECM will energize the solenoid for the dual stage load sensing relief valve. The load sensing relief valve will limit the maximum pressure to the higher setting.

> ***NOTE:*** *Although the outer two envelopes on each end of the auxiliary/high flow spool are identical on the schematic, more flow is allowed through the outermost envelopes.*

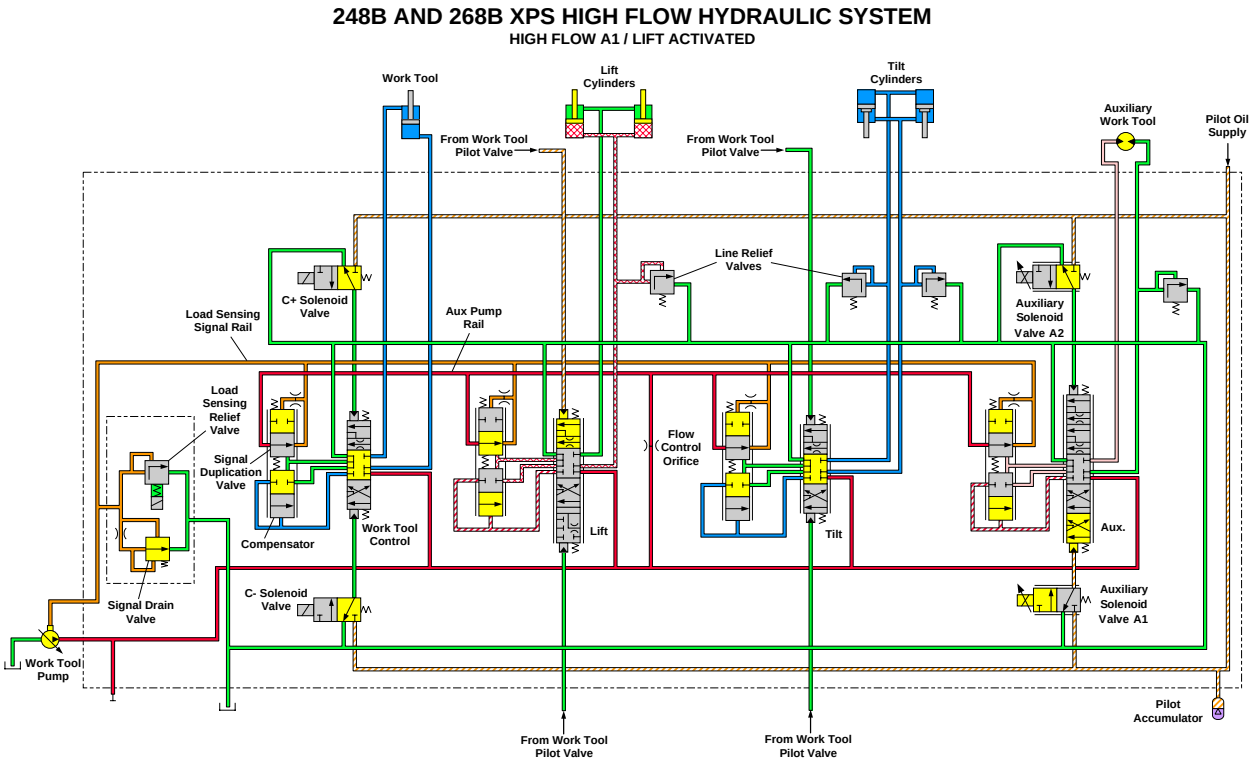
248B AND 268B HIGH FLOW VALVE

HIGH FLOW ACTIVE



126

This illustration shows a cutaway view of the high flow work tool valve with only the high flow circuit activated. The signal duplication valve for the auxiliary/high flow circuit meters oil from the auxiliary pump supply rail to the load sensing signal rail.



127

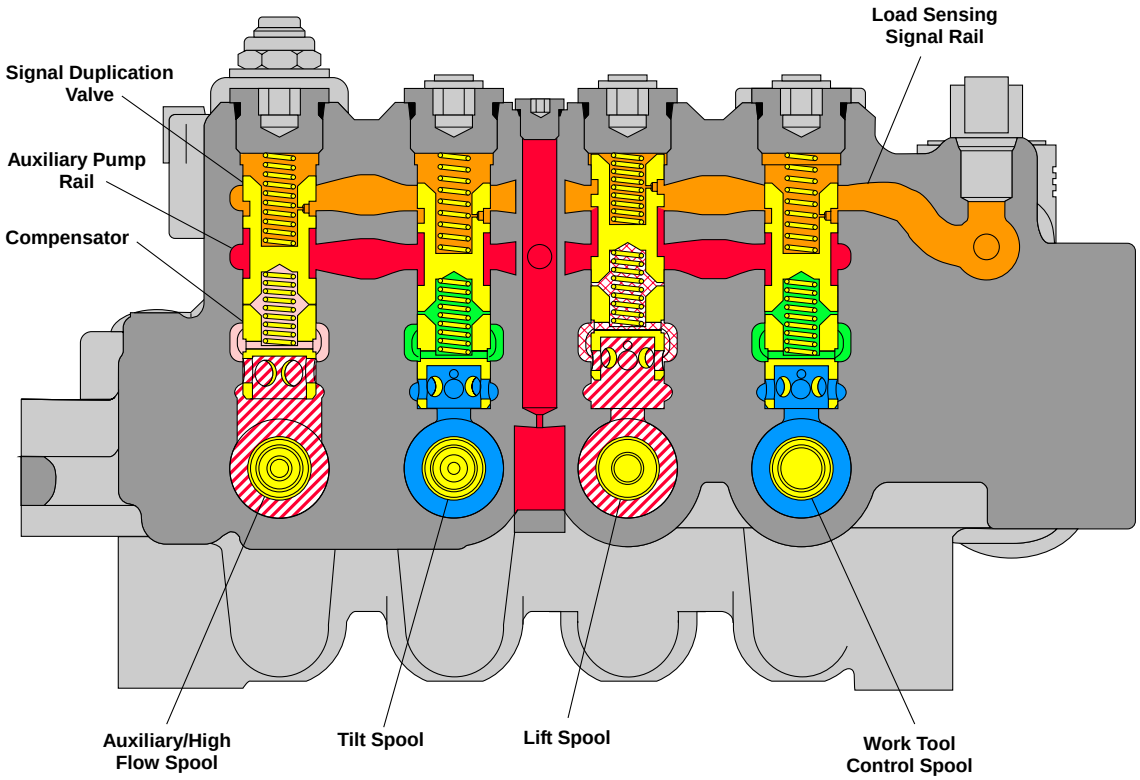
This illustration shows the high flow hydraulic system with the high flow circuit and the lift circuit activated simultaneously. In this illustration, the pressure required by the lift circuit is higher than the pressure required by the high flow circuit. Therefore, the pressure felt below the signal duplicational valve for the lift circuit is greater than the pressure felt below the signal duplication valve for the high flow circuit. The signal duplication valve for the lift circuit duplicates the lift circuit work port pressure into the load sensing passage as previously described.

Because the pressure in the load sensing passage is higher than the pressure below the signal duplication valve for the high circuit, the signal duplication valve for the high flow circuit moves downward. Only the lift circuit generates a load sensing signal.

Since another circuit is active along with the high flow circuit, the Auxiliary Hydraulic ECM will still send 2.0 amps to the auxiliary hydraulic solenoid. However, the Auxiliary Hydraulic ECM will de-energize the solenoid for the dual stage load sensing relief valve. The load sensing relief valve will limit the maximum pressure to the lower setting.

248B AND 268B HIGH FLOW VALVE

HIGH FLOW / LIFT ACTIVE



128

This illustration shows a cutaway view of the work tool valve compensators and signal duplication valves with the high flow circuit and lift circuit active. The signal duplication valve for the lift circuit moves upward to allow auxiliary pump pressure oil flow into the load sensing signal passage until the pressure above the signal duplication valve equals the work port pressure below the signal duplication valve.

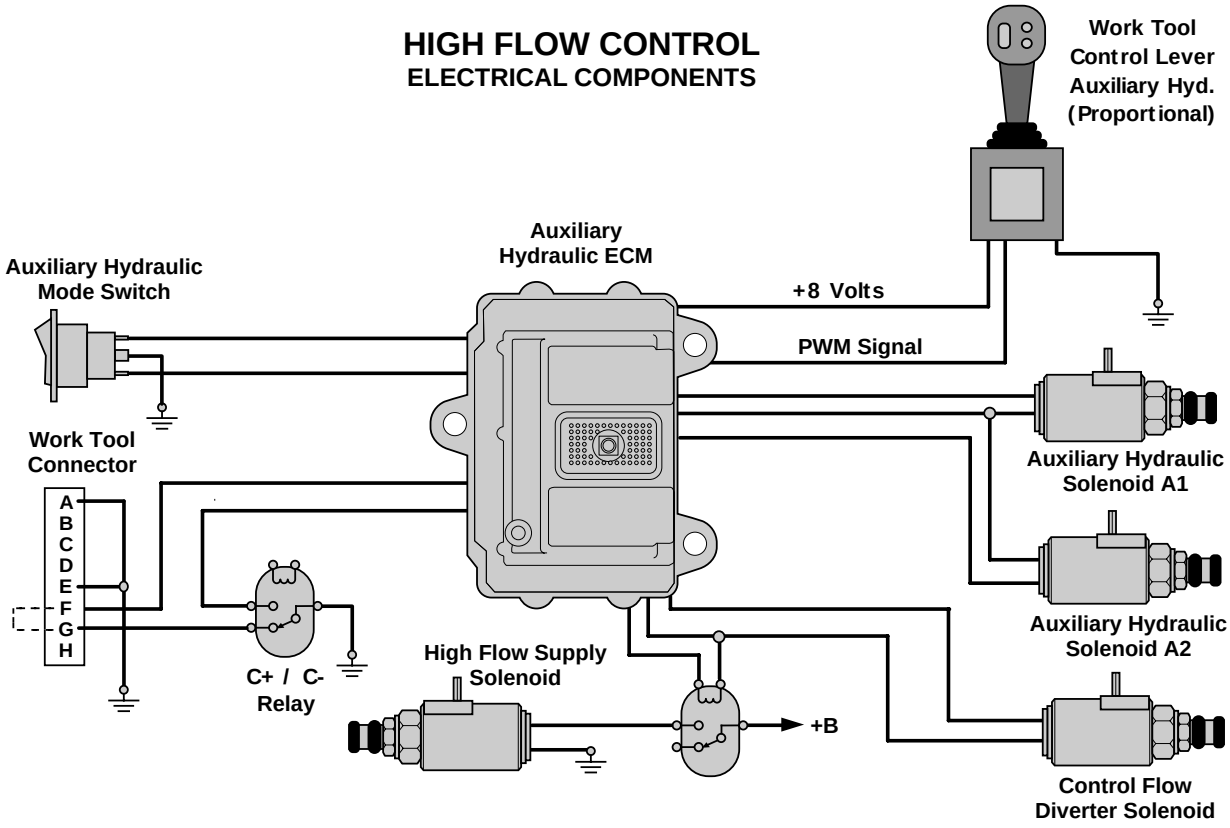
The remaining signal duplication valves move downward against the compensators.

129

226B/242B/257B High Flow (Optional)

The optional high flow system used on the 226B, 242B, and 257B functions differently than the system used on the 248B and 268B. The 226B, 242B, and 257B high flow system uses an additional gear pump to "boost" the flow of the auxiliary hydraulic circuit in one direction or to supply oil to the C+/C- control circuits.

A PC205 Cold Planer is shown in this illustration.



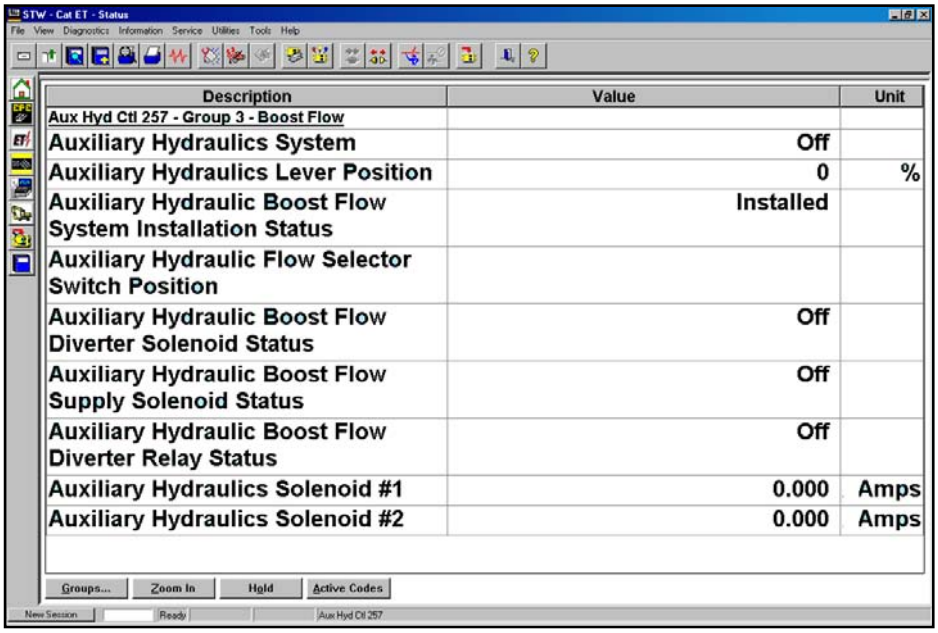
130

The high flow system is controlled by the Auxiliary Hydraulic ECM. When standard flow is selected with the auxiliary hydraulic mode switch, the Auxiliary Hydraulic ECM monitors the auxiliary hydraulic control thumb switch and the ECM will energize the "A1" or "A2" solenoid proportionately.

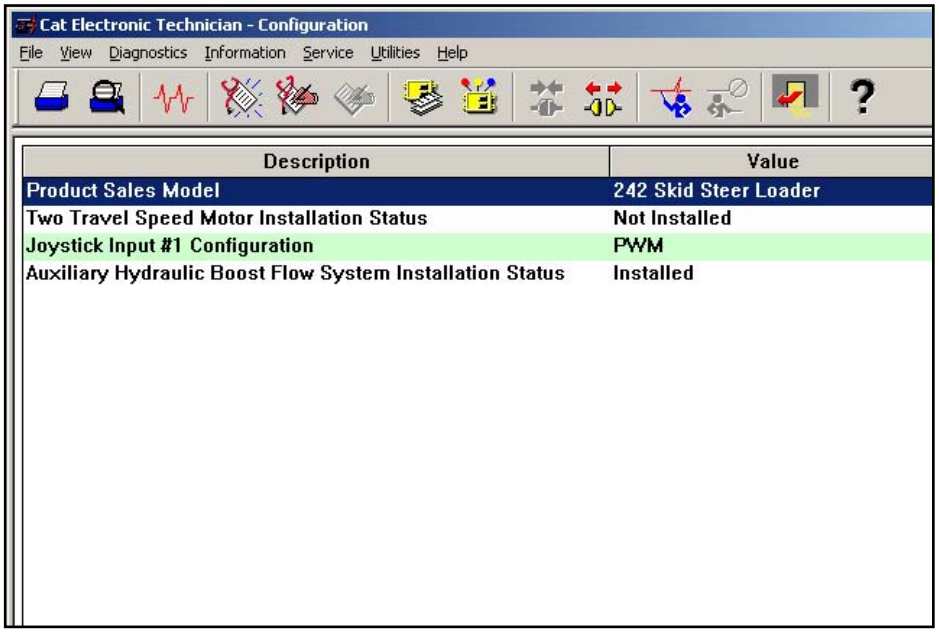
When high flow is selected and the "A2" control is activated, the Auxiliary Hydraulic ECM will energize the "A2" solenoid proportionately and will also energize the high flow supply solenoid and the control flow diverter solenoid. The high flow supply solenoid and control flow diverter solenoid are de-energized when the "A2" control is released. The high flow supply solenoid and control flow diverter solenoid are also de-energized when the "A1" control is active.

When the C+ or C- control is activated, the Auxiliary Hydraulic ECM will energize the control diverter solenoid. The high flow gear pump will then supply oil to the C+/C- circuits.

When high flow is selected with the “A2” control activated and the C+ or C- control is activated, the Auxiliary Hydraulic ECM will de-energize the high flow supply solenoid. The high flow gear pump will then supply oil to the C+/C- circuits.



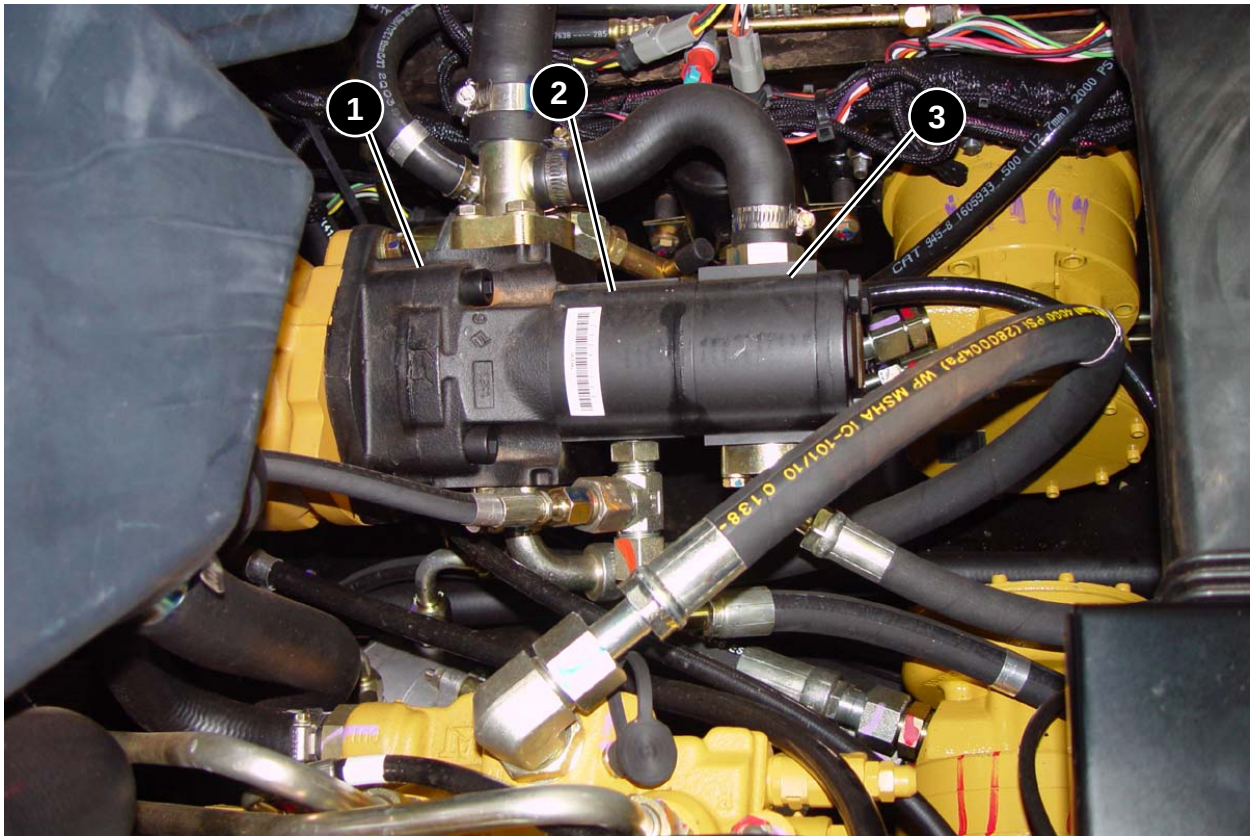
131



132

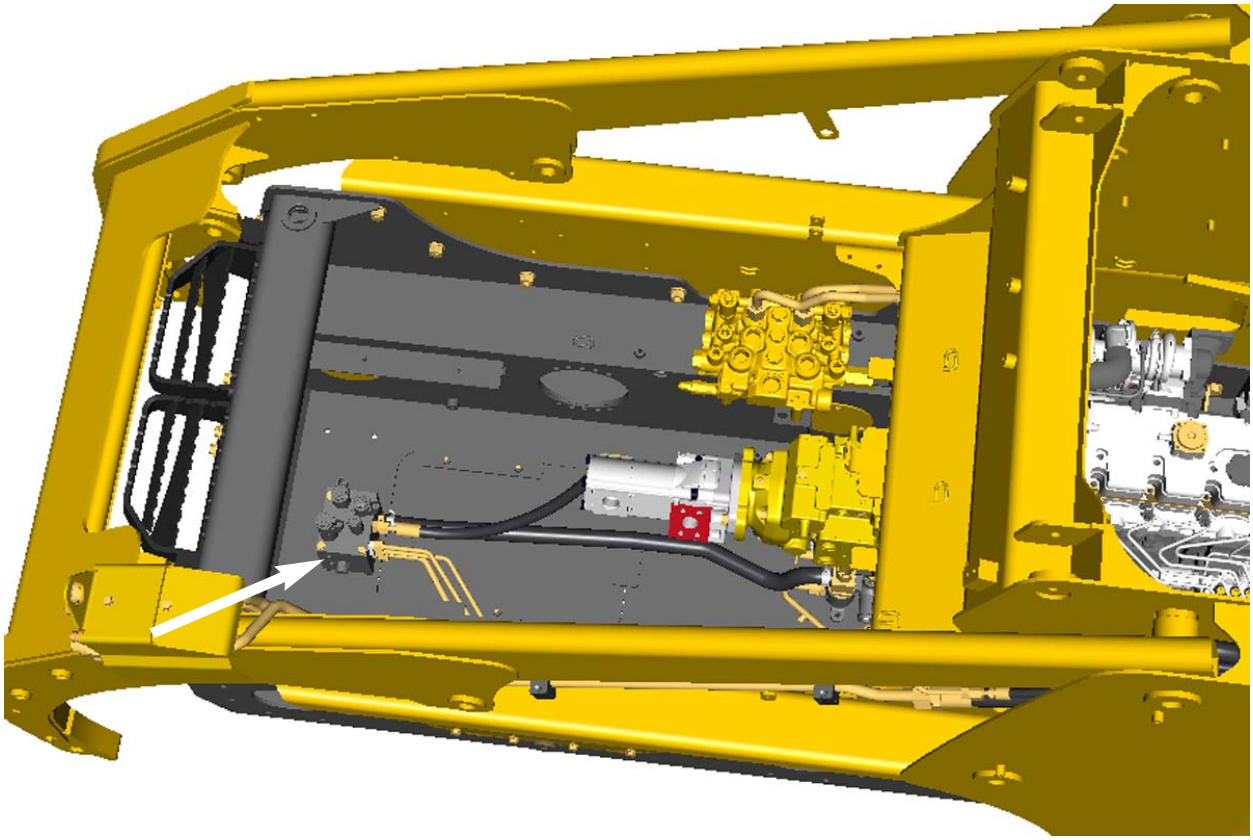
Cat ET must be used to configure the Auxiliary Hydraulic ECM for high flow as shown in the top illustration.

The status screens can be used to determine the status of various components while troubleshooting the high flow system.



133

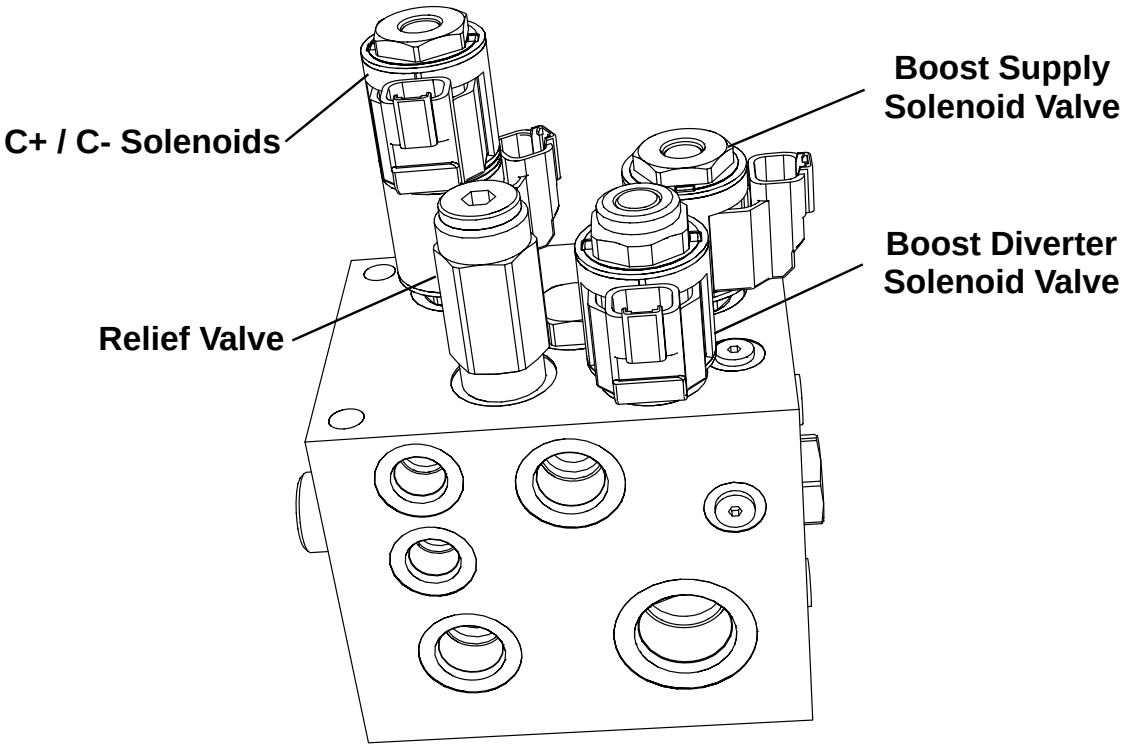
The high flow system uses an additional gear pump (3) at the end of the charge pump (2). The work tool pump (1) is also visible in this illustration.



134

The high flow valve group (arrow) is located under the floor plate at the front of the machine. The high flow valve contains the solenoids for the high flow and work tool control circuits (C+/C-).

HIGH FLOW VALVE
COMPONENT IDENTIFICATION



135

This illustration shows the components of the high flow valve. The high flow valve components include: the high flow supply solenoid valve, the control diverter solenoid valve, the "C+/C-" solenoid valve, and a relief valve.

The boost supply solenoid valve is energized when the high flow system is enabled by the auxiliary hydraulic mode switch and the "A2" circuit is active. The boost supply solenoid valve directs pump supply oil to either the work tool control circuit or to the high flow circuit.

The boost diverter solenoid valve is energized when the high flow system is enabled by the auxiliary hydraulic mode switch and the "A2" circuit is active. The boost diverter solenoid valve is also energized when the "C+/C-" function is active. The boost diverter solenoid valve blocks pump supply oil back to tank or allows pump supply oil to flow back to tank.

The "C+/C-" solenoid valve controls oil flow for the work tool control circuit. The solenoid valve is a "push/pull" type solenoid valve with two coils. The top coil is controlled by C- and the bottom coil is controlled by C+.

The relief valve protects the high flow pump from excessive pressures.

136

An electrical connector (1) provides electrical power to a three-position diverter valve located on some work tools.

The work tool auxiliary hydraulic lines and electrical connector are located on the left lift arm of the machine. The auxiliary hydraulic lines allow oil flow to and from the work tools. The lines are equipped with quick disconnects.

The center left quick disconnect (2) supplies oil for high flow work tools when the "A2" control is activated. The bottom left quick disconnect (3) supplies oil for standard work tools when the "A2" control is activated.

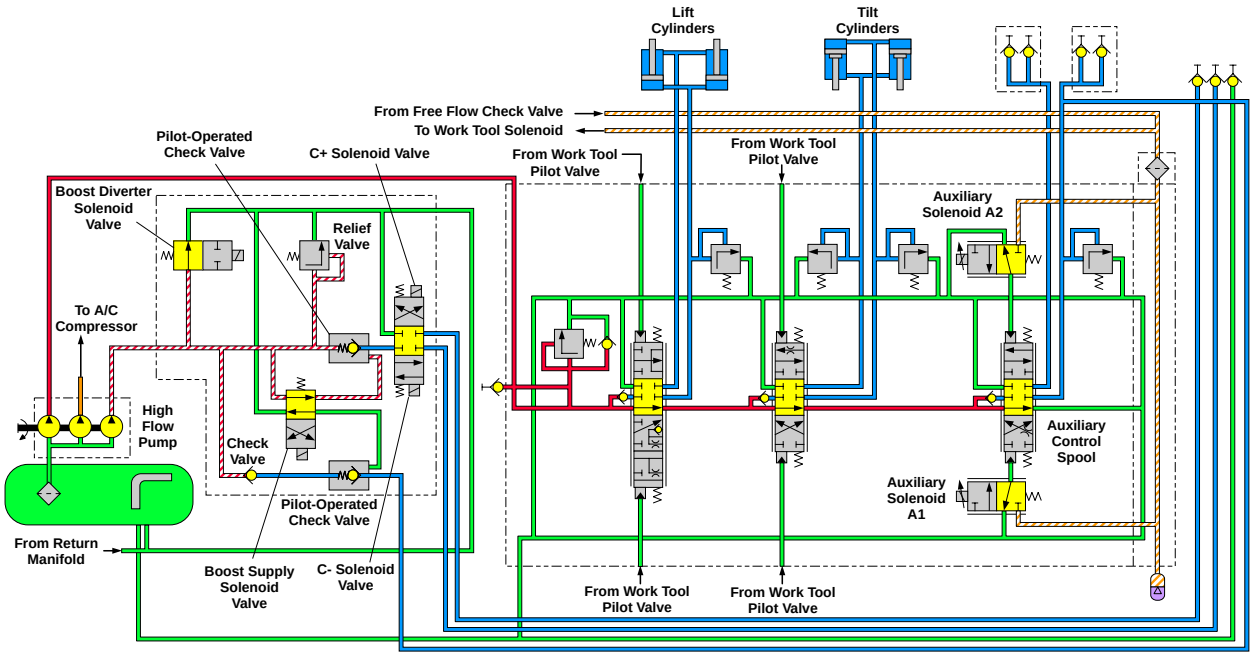
The center right quick disconnect (4) supplies oil for high flow work tools when the "A1" control is activated. The bottom right quick disconnect (5) supplies oil for standard work tools when the "A1" control is activated.

The top left quick disconnect (6) supplies oil for the control circuit on some work tools when the "C+" control is activated. The top right quick disconnect (7) supplies oil for the control circuit on some work tools when the "C-" control is activated.

The center quick disconnect (8) is a return line to tank.

226B / 242B / 257B OPTIONAL HIGH FLOW HYDRAULIC SYSTEM

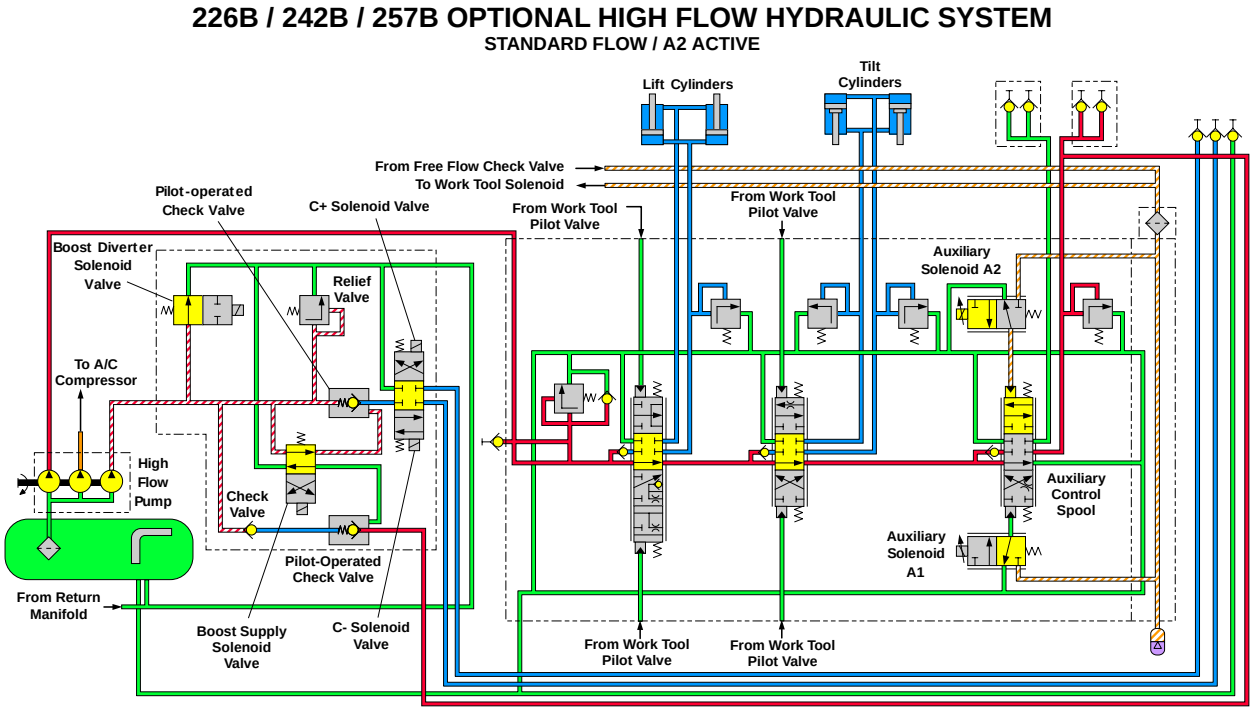
STANDARD FLOW / NOT ACTIVE



137

This illustration shows the components of the high flow system. Flow for the auxiliary circuit is supplied by the work tool pump through the standard open-centered control valve.

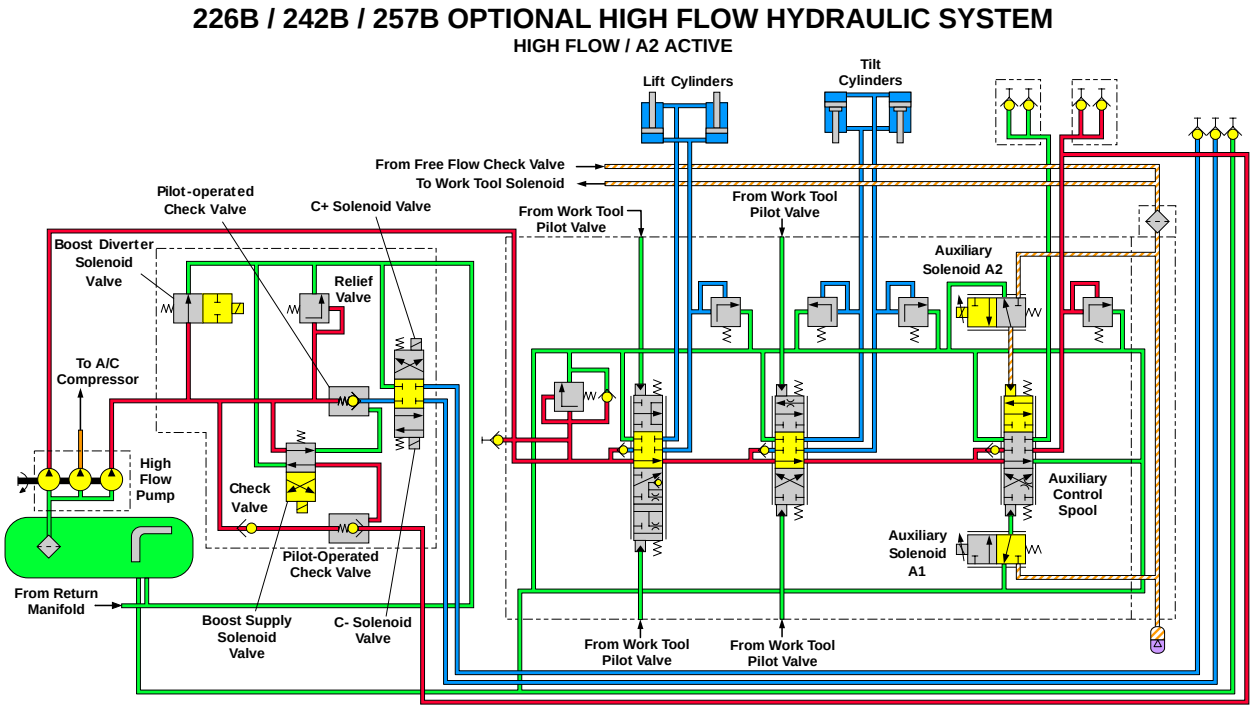
With standard flow selected, flow from the high flow gear pump flows through the de-energized high flow boost diverter solenoid valve to tank.



138

When the operator activates the "A2" control, the "A2" solenoid valve energizes. Pilot oil is allowed through the solenoid valve to shift the auxiliary control spool. The auxiliary flow to the work tool is blocked from entering the high flow valve by the pilot-operated check valve.

With standard flow selected, the high flow boost diverter solenoid valve remains de-energized and flow from the high flow gear pump is directed to tank.



139

When the "A2" control is activated while the high flow is enabled with the auxiliary hydraulic mode switch, the Auxiliary Hydraulic ECM energizes the "A2" solenoid, the boost supply solenoid, and the diverter solenoid valve. When the boost diverter solenoid valve energizes, flow from the high flow gear pump is blocked to tank, causing pressure to build. When the boost supply solenoid valve energizes, some of the flow from the high flow pump is directed to open the pilot-operated check valve in the circuit to the auxiliary work tool.

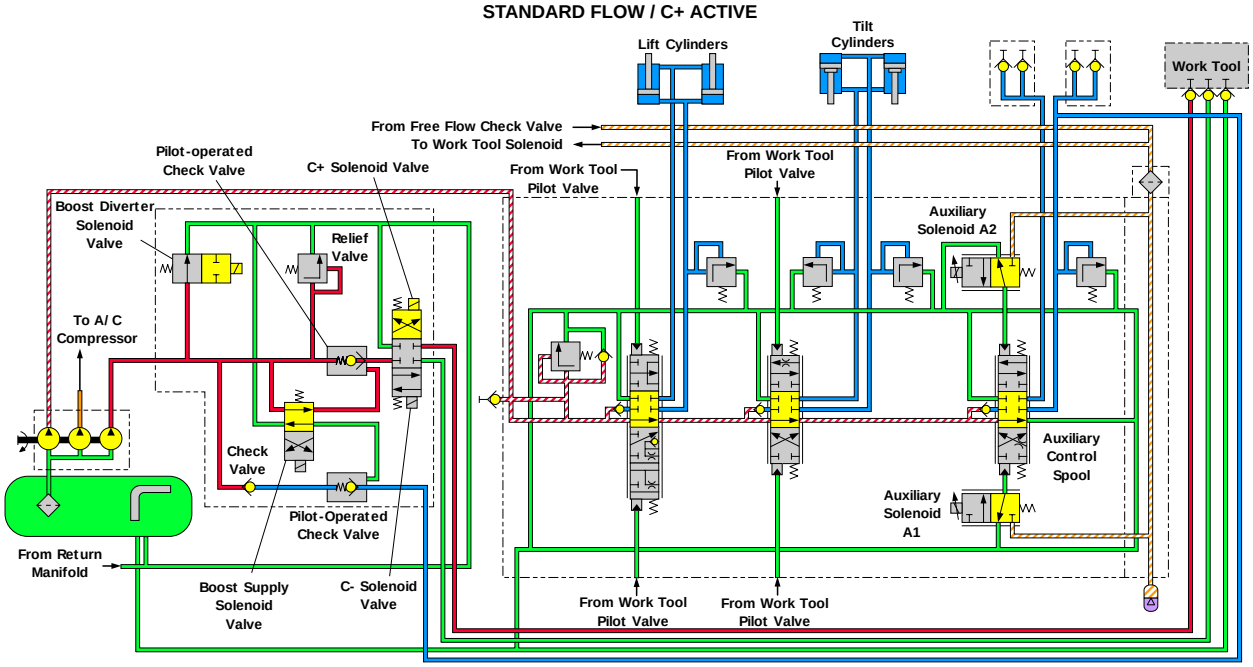
Flow from the high flow gear pump is also directed to the check valve in the high flow circuit. The check valve acts as a load check valve, remaining closed until the pressure from the high flow pump is greater than the pressure in the "A2" circuit. When the load check valve opens, flow from the high flow gear pump flows through the pilot-operated check valve into the "A1" circuit.

A relief valve in the high flow valve protects the high flow valve and high flow gear pump from excessive pressure.

***NOTE*:** *The high flow supply solenoid and the control diverter solenoid are NOT energized when the "A1" circuit is activated.*

226B / 242B / 257B OPTIONAL HIGH FLOW HYDRAULIC SYSTEM

STANDARD FLOW / C+ ACTIVE



140

The work tool control circuit is controlled by the "C+" and "C-" solenoid valves. When the operator depresses the "C+" or "C-" switch on the work tool control lever, the "C+" or "C-" and "C+/C-" relays are energized. The "C+" or "C-" relay energizes the "C+" or "C-" solenoid valve. The "C+/C-" relay signals the Auxiliary Hydraulic ECM. The high flow supply solenoid valve is then energized by the Auxiliary Hydraulic ECM.

The energized diverter solenoid valve blocks the oil flow from the high flow gear pump to tank, causing pressure to build. The rising pressure opens the pilot-operated check valve through the boost supply solenoid valve, allowing flow from high flow gear pump to be available to the "C+/C-" control spool. As the "C+/C-" control spool is shifted by the solenoid, oil from the high flow gear pump flows to the work tool control circuit. Return oil flows across the control spool to tank.

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CONCLUSION

This presentation has discussed the component locations and machine systems operation for B-Series Skid Steer and Multi-Terrain Loaders.

When used in conjunction with the service manual, the information in this package should permit the technician to do a thorough job of analyzing a problem in these systems.

Always refer to the service manual for the latest service information and specifications when servicing, testing and adjusting, or making repairs.

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HYDRAULIC SCHEMATIC COLOR CODE

- Black - Mechanical Connection. Seal
- Dark Gray - Cutaway Section
- Light Gray - Surface Color
- White - Atmosphere or Air (No Pressure)
- Purple - Pnuematic Pressure
- Yellow - Moving or Activated Components
- Cat Yellow - (Restricted Usage) Identification of Components Within a Moving Group
- Brown - Lubricating Oil
- Green - Tank, Sump, or Return Oil
- Green / White Stripes - Scavenge Oil or Hydraulic Void
- Red - High Pressure Oil
- Red / White Stripes - 1st Pressure Reduction
- Red Crosshatch - 2nd Reduction in Pressure
- Pink - 3rd Reduction in Pressure
- Red / Pink Stripes - Secondary Source Oil Pressure
- Orange - Pilot, Signal or Torque Converter Oil
- Orange / White Stripes - Reduced Pilot, Signal or TC Oil Pressure
- Orange Crosshatch - 2nd Reduction in Pilot, Signal or TC Oil Pressure.
- Blue - Trapped Oil

HYDRAULIC SCHEMATIC COLOR CODE

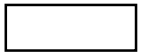
This illustration identifies the meanings of the colors used in the hydraulic schematics and cross-sectional views shown throughout this presentation.

HYDRAULIC SCHEMATIC COLOR CODE

Black - Mechanical Connection. Seal

Dark Gray - Cutaway Section

Light Gray - Surface Color



White - Atmosphere or Air (No Pressure)

Purple - Pnuematic Pressure

Yellow - Moving or Activated Components

Cat Yellow - (Restricted Usage)
Identification of Components
Within a Moving Group

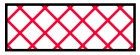
Brown - Lubricating Oil

Green - Tank, Sump, or Return Oil

Green / White Stripes -
Scavenge Oil or Hydraulic Void

Red - High Pressure Oil

Red / White Stripes - 1st Pressure Reduction



Red Crosshatch - 2nd Reduction in Pressure

Pink - 3rd Reduction in Pressure

Red / Pink Stripes - Secondary Source Oil Pressure

Orange - Pilot, Signal or Torque Converter Oil

Orange / White Stripes -
Reduced Pilot, Signal or TC Oil Pressure

Orange Crosshatch - 2nd Reduction in
Pilot, Signal or TC Oil Pressure.

Blue - Trapped Oil

Skid Steer Loader / Multi-Terrain Loader
Abbreviation and Acronym Glossary

The following abbreviations and acronyms may be used in some Caterpillar literature regarding skid steer loaders and multi-terrain loaders.

Controls

A1 — Auxiliary Hydraulic circuit No. 1

A2 — Auxiliary Hydraulic circuit No. 2

C- — Work tool control circuit operated by the upper right momentary switch on the optional work tool control lever

C+ — Work tool control circuit operated by the lower right momentary switch on the optional work tool control lever

C1 — C1 is an auxiliary electrical control for pin C of the optional work tool electrical connector located on the left lift arm. C1 is energized when the upper right momentary switch on the optional speed and direction control lever is depressed.

C2 — C2 is an auxiliary electrical control for pin D of the optional work tool electrical connector located on the left lift arm. C2 is energized when the lower right momentary switch on the optional speed and direction control lever is depressed.

Pressure Ports

G1 — Charge pressure tap

MA1 — MA1 refers to the reverse drive loop of the pump for the left side of the machine.

MA2 — MA2 refers to the reverse drive loop of the pump for the right side of the machine.

MB1 — MB1 refers to the forward drive loop of the pump for the left side of the machine.

MB2 — MB2 refers to the forward drive loop of the pump for the right side of the machine.

Y — Speed sensing pressure tap

"B" SERIES SSL / MTL FAMILIES

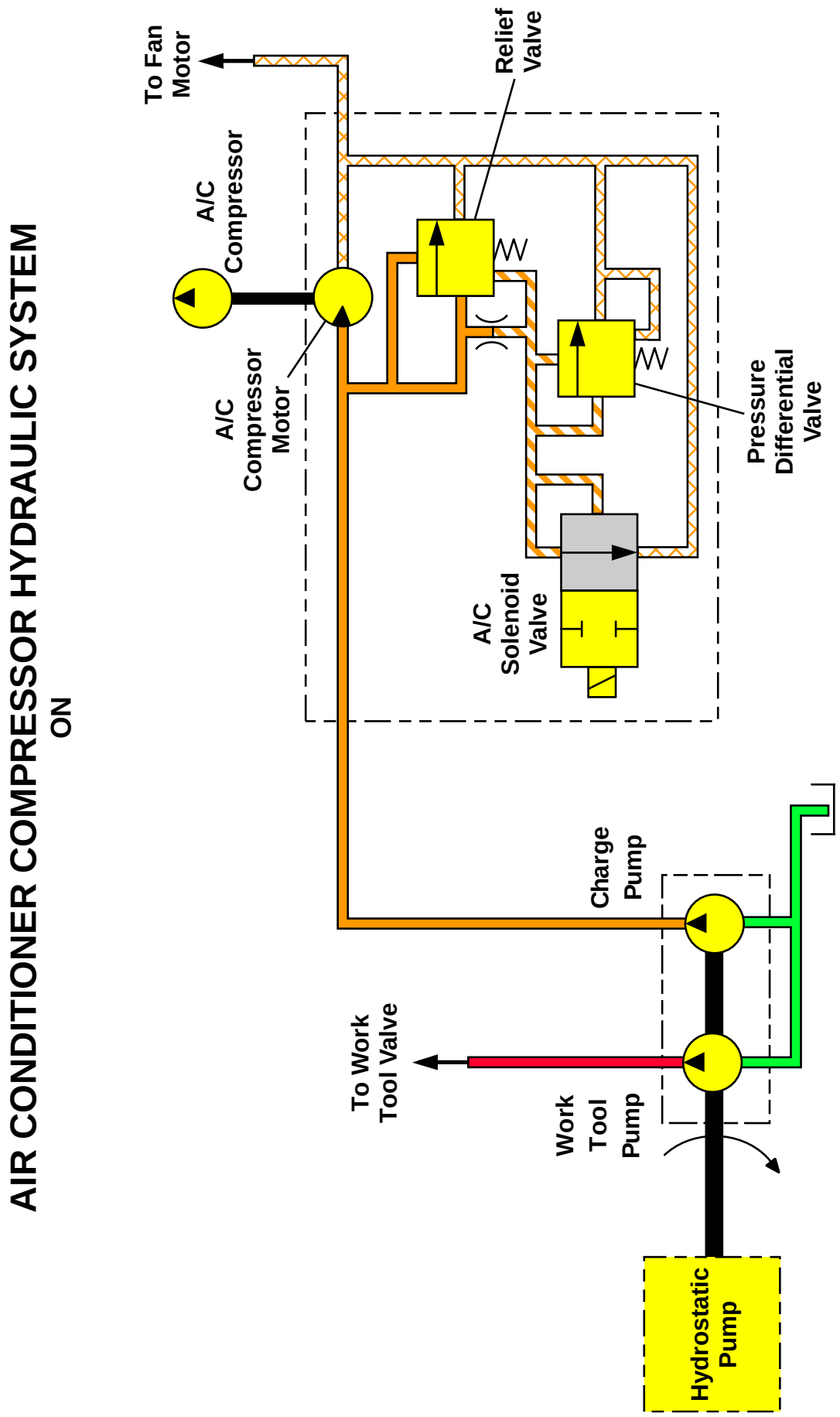
FOUR BASE MACHINES

Base Machine	XR	MTL	MTL/XR	XPS HF	XPS HF/ XR	Engine
216B (RLL)	232B (SCH)					3024C
226B (MJH)	242B (BXM)	247B (MTL)	257B (SLK)			3024CT
236B (HEN)	252B (SCP)	267B (CYC)				3044C DIT
246B (PAT)	262B (PDT)	277B (MDH)	287B (ZSA)	248B (SCL)	268B (LBA)	3044C DIT

XR = Extended Reach
MTL = Multi-Terrain Loader
HF = High Flow
High Flow Optional
Two-Speed Optional

AIR CONDITIONER COMPRESSOR HYDRAULIC SYSTEM

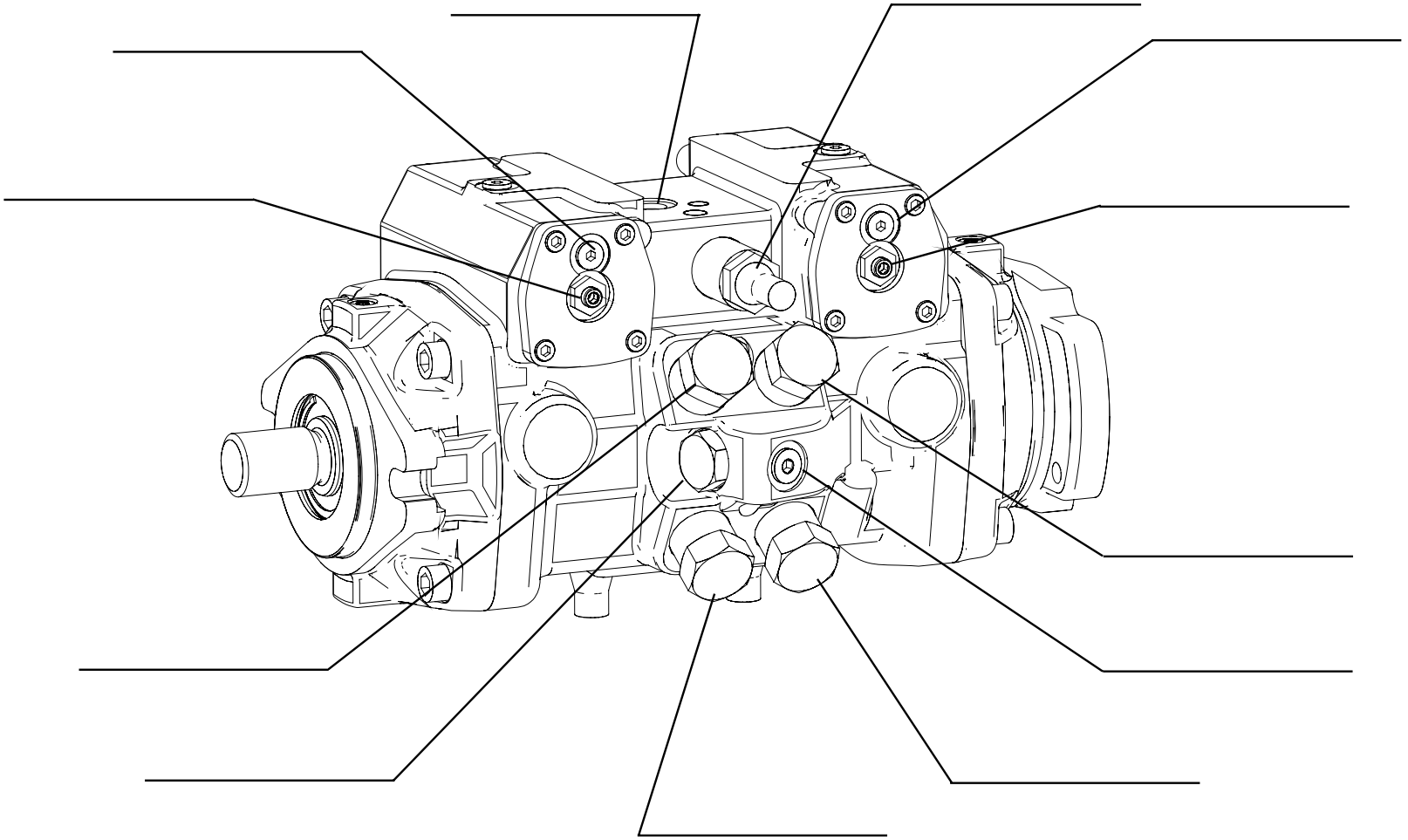
ON



Directions: Write the name of the hydrostatic pump component in the space provided.

HYDROSTATIC DRIVE PUMP

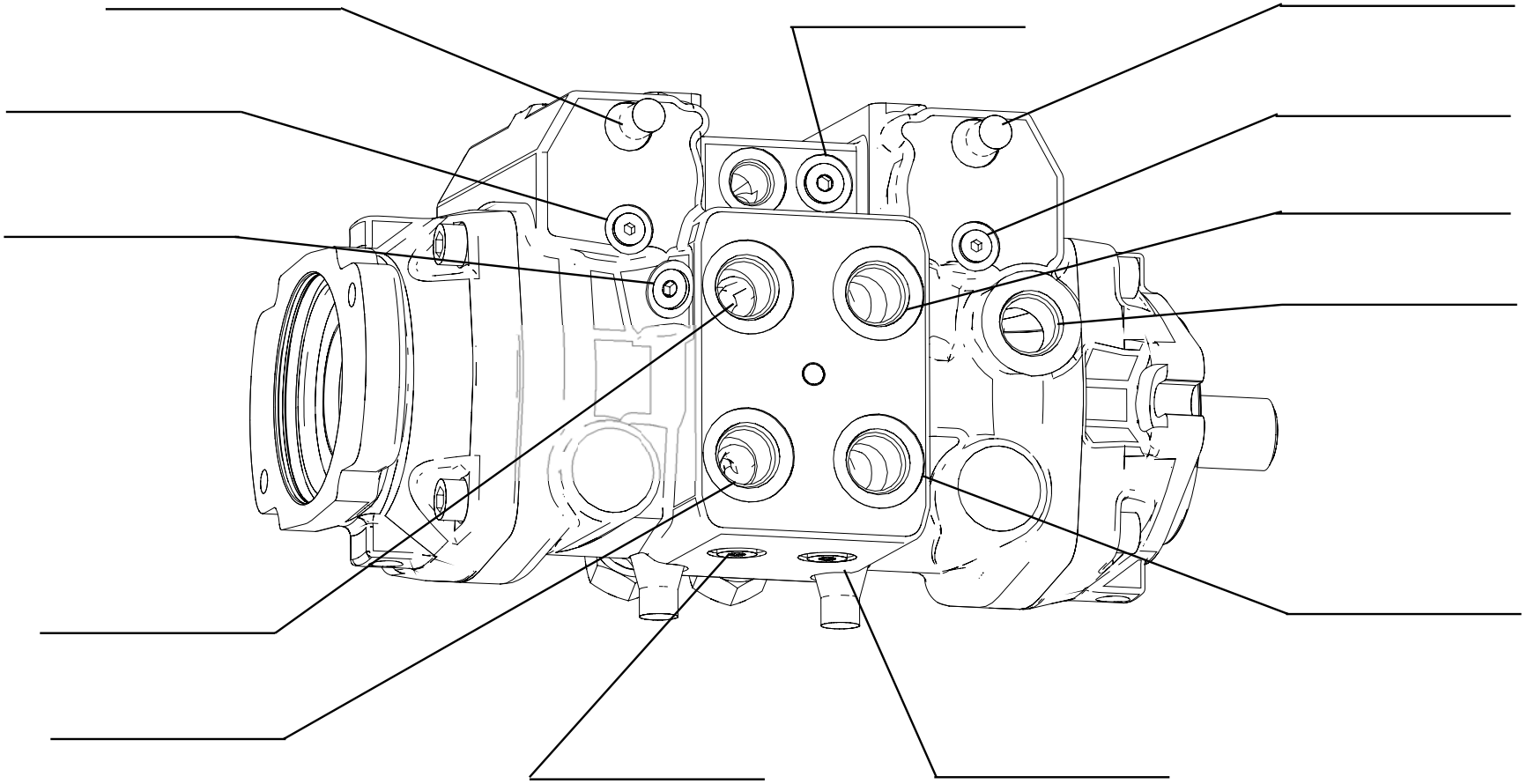
COMPONENTS



Directions: Write the name of the hydrostatic pump component in the space provided.

HYDROSTATIC DRIVE PUMP

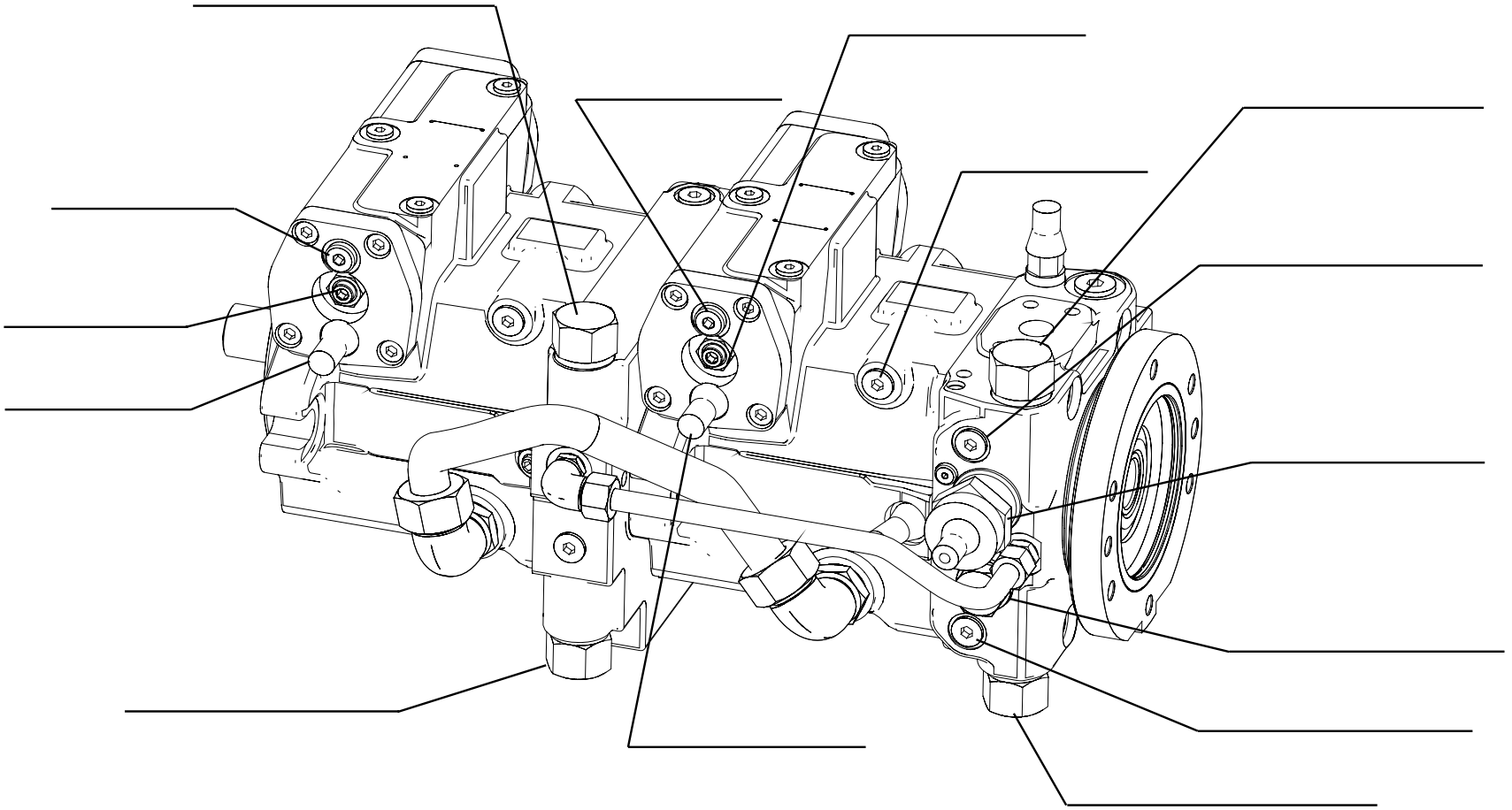
COMPONENTS



Directions: Write the name of the hydrostatic pump component in the space provided.

267B / 277B / 287B HYDROSTATIC DRIVE PUMP

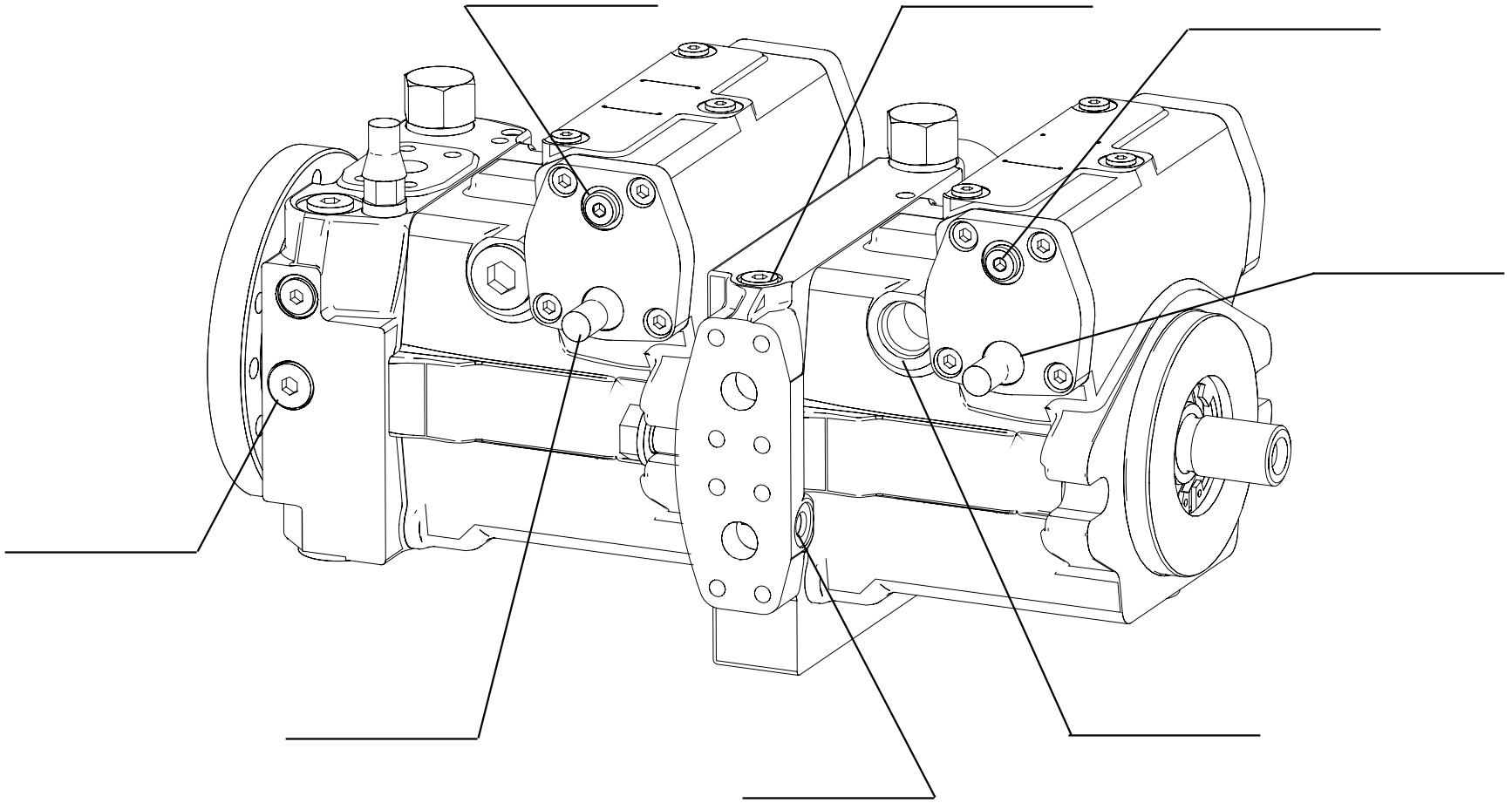
COMPONENTS

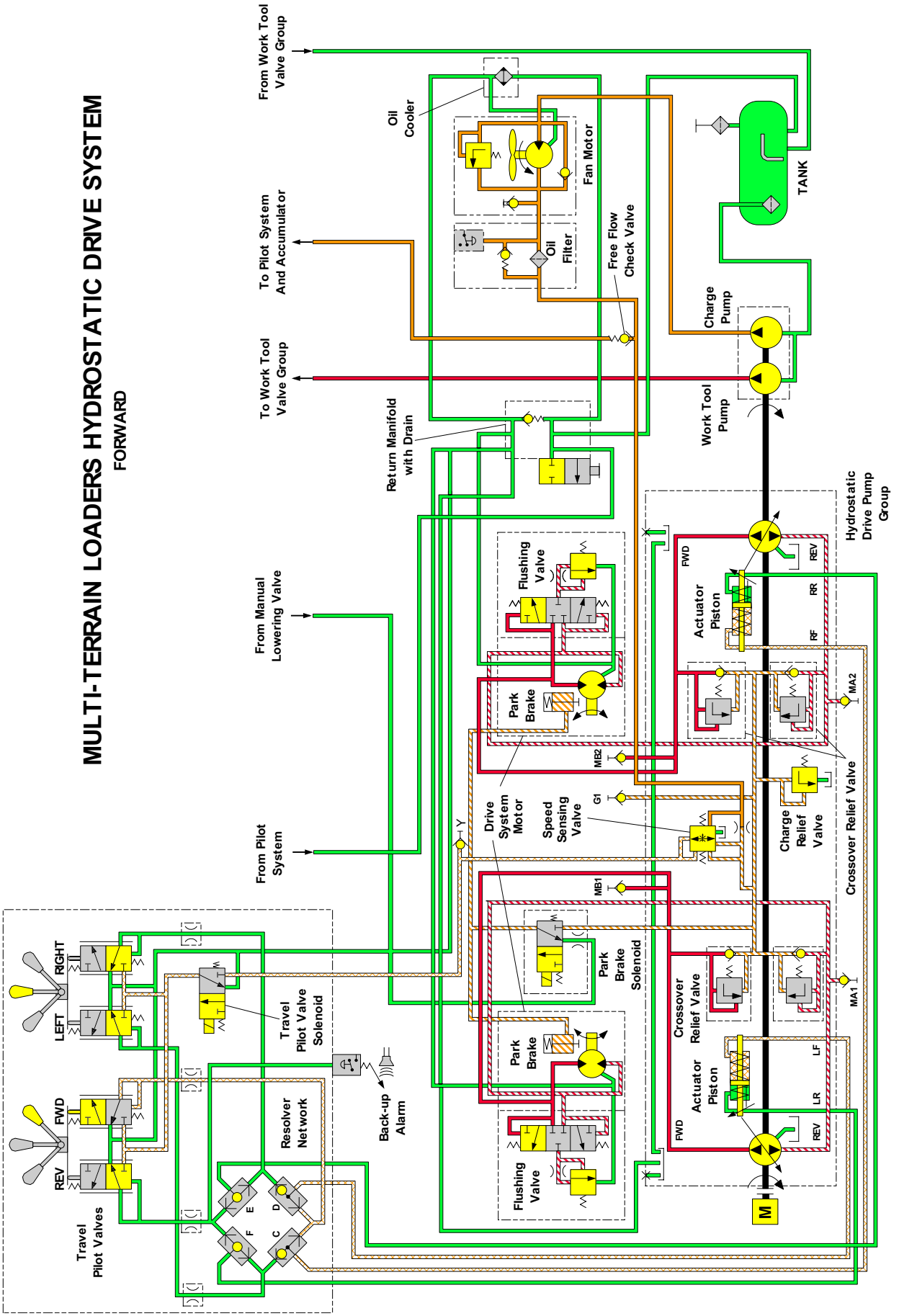


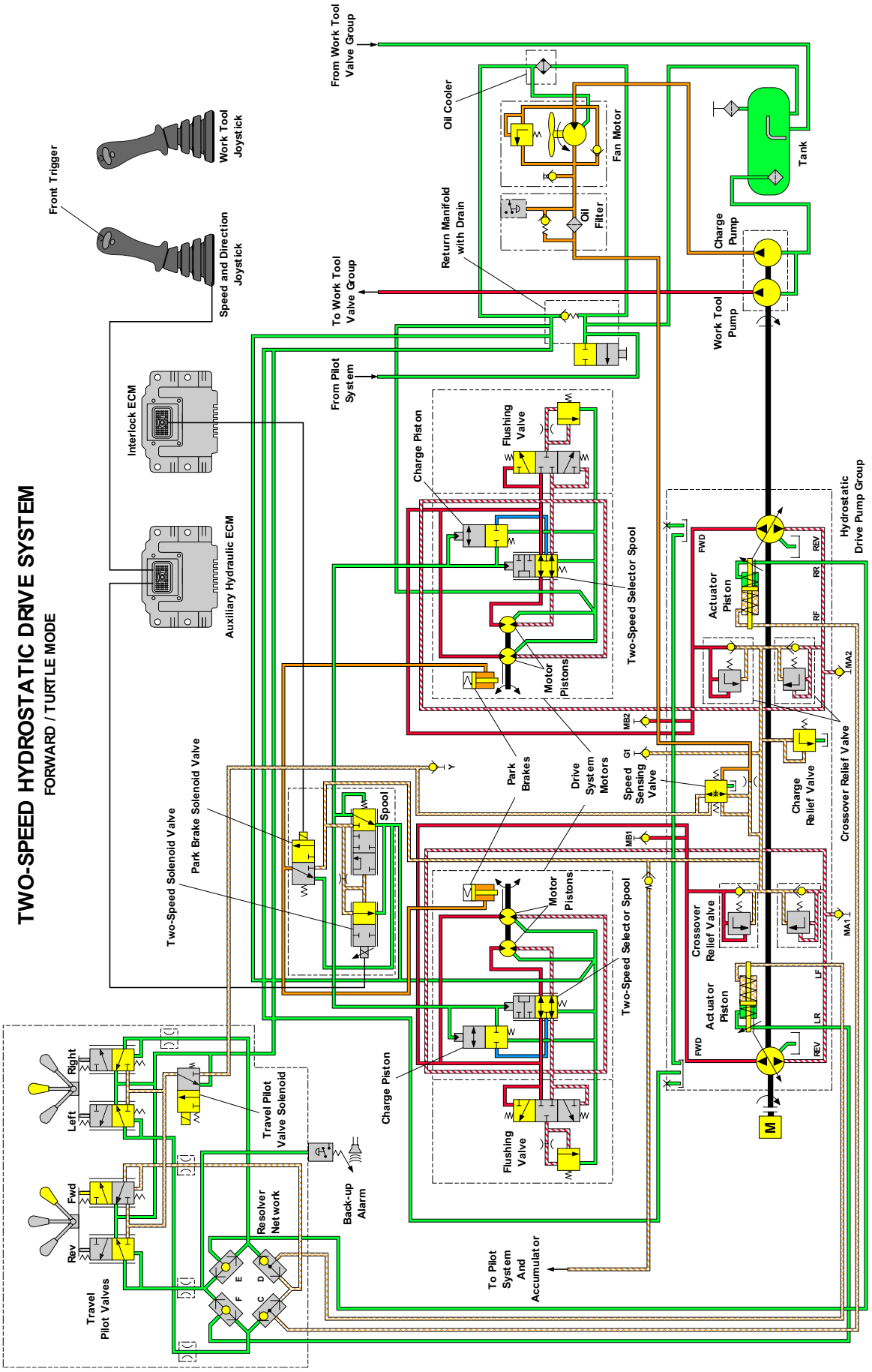
Directions: Write the name of the hydrostatic pump component in the space provided.

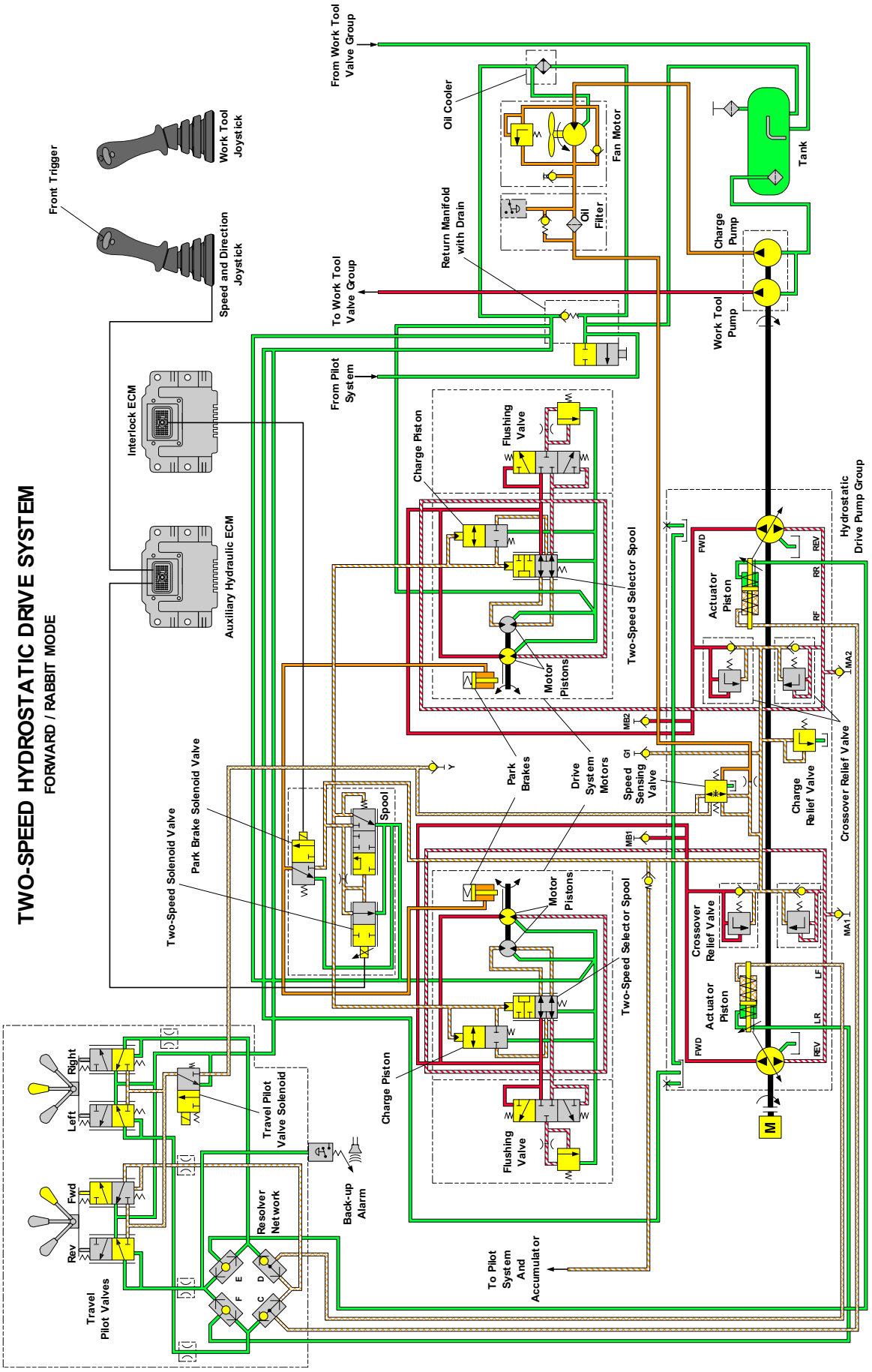
267B / 277B / 287B HYDROSTATIC DRIVE PUMP

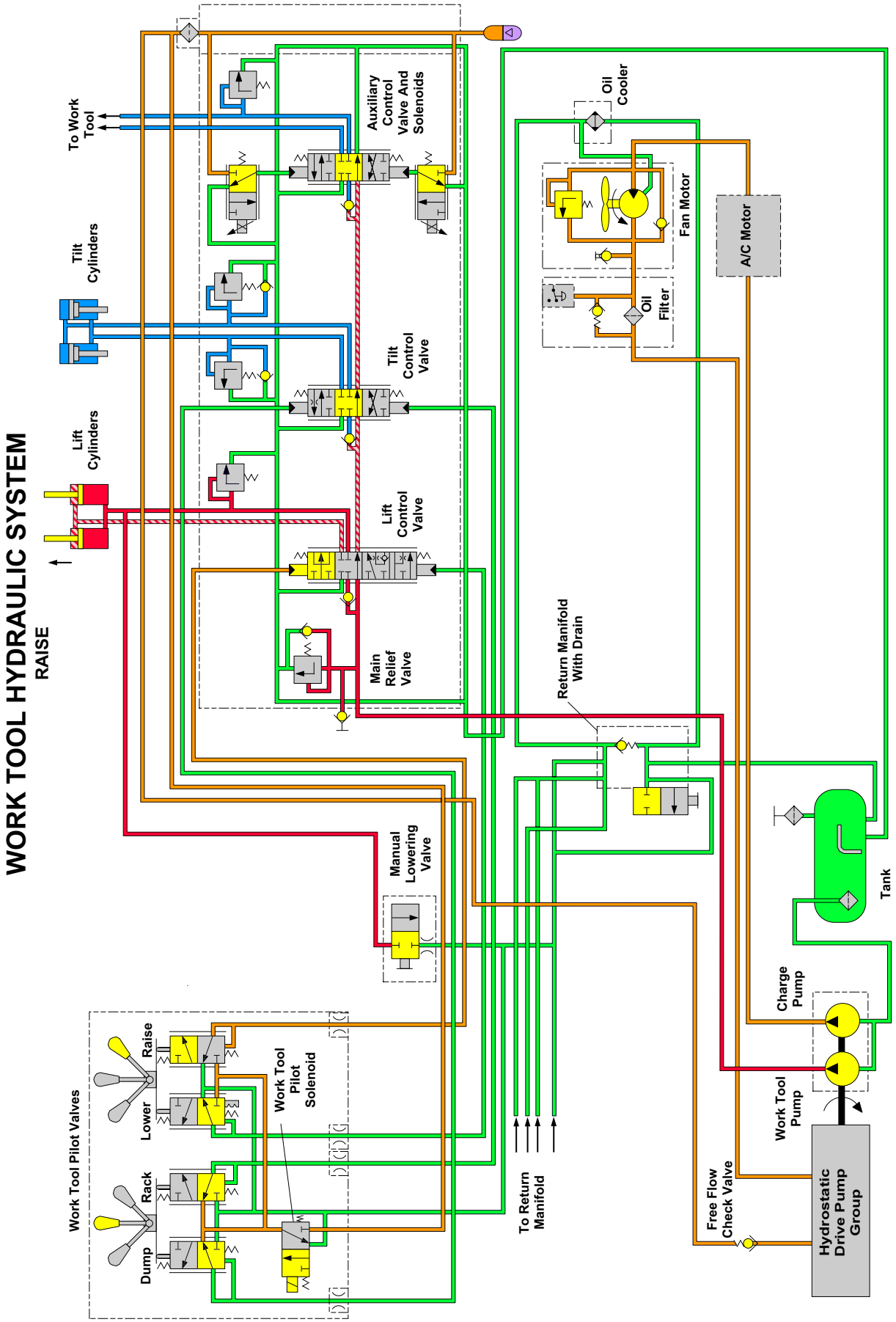
COMPONENTS

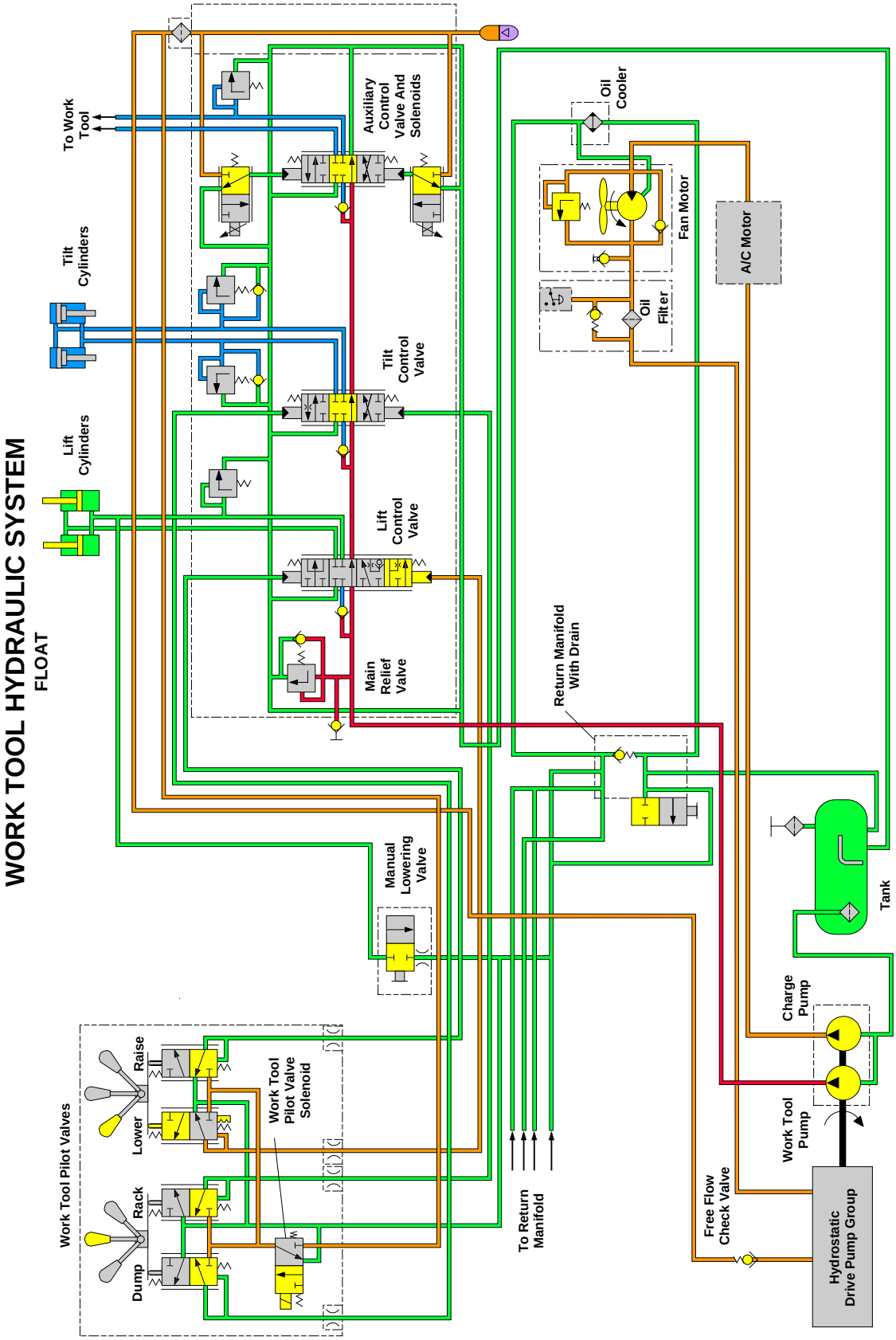


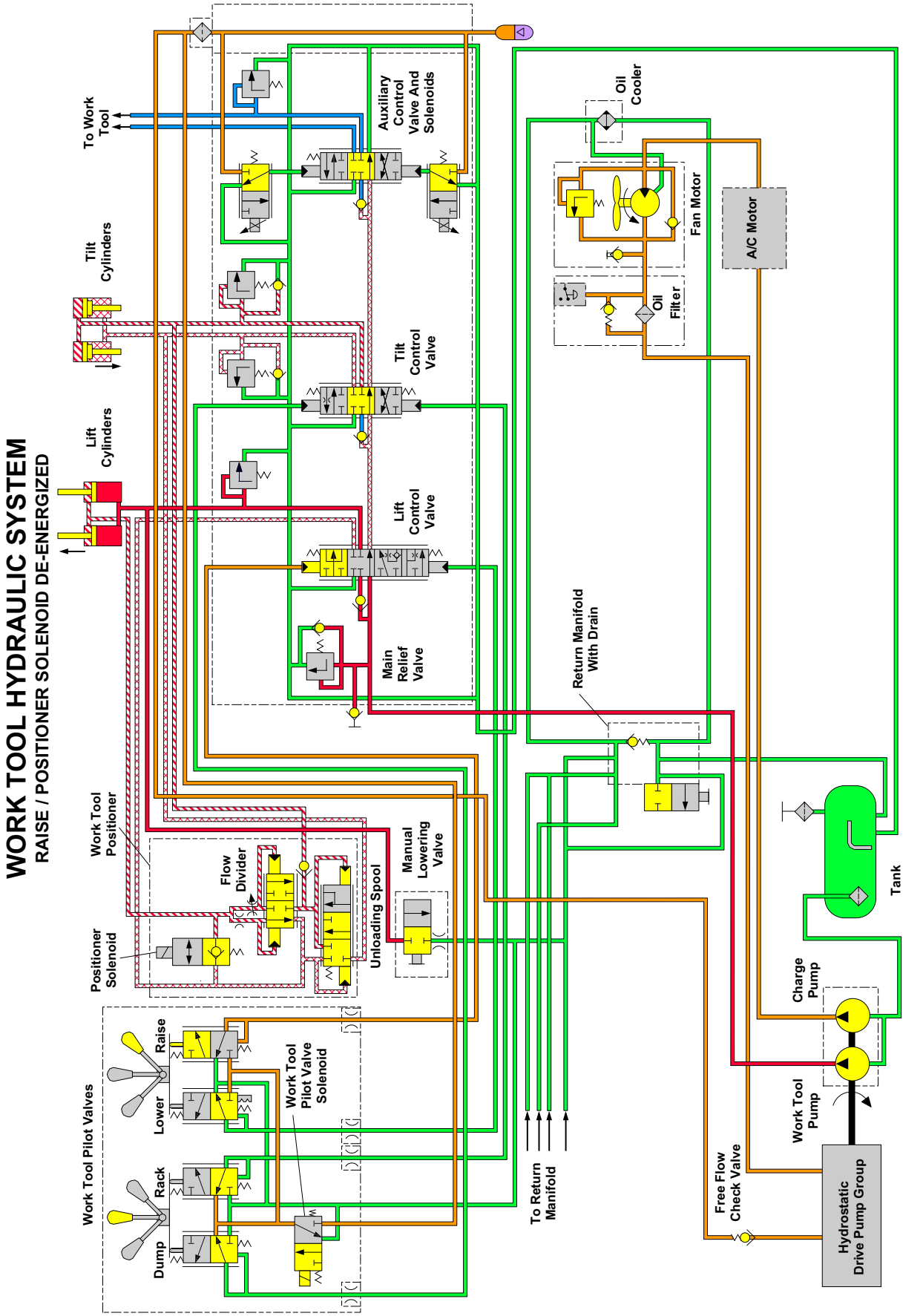

MULTI-TERRAIN LOADERS HYDROSTATIC DRIVE SYSTEM
FORWARD
From Work Tool Valve Group
Oil Cooler
Fan Motor
To Pilot System And Accumulator
Oil Filter
Free Flow Check Valve
TANK
To Work Tool Valve Group
Charge Pump
Work Tool Pump
Return Manifold with Drain
Hydrostatic Drive Pump Group
From Manual Lowering Valve
Flushing Valve
Actuator Piston
FWD
REV
RR
RF
LF
LR
Park Brake
MA2
MB2
From Pilot System
Drive System Motor
Speed Sensing Valve
G1
Y
Charge Relief Valve
Crossover Relief Valve
MB1
Park Brake Solenoid
Crossover Relief Valve
MA1
Travel Pilot Valve Solenoid
Resolver Network
Back-up Alarm
Travel Pilot Valves
RIGHT
LEFT
FWD
REV
E
D
F
C
M

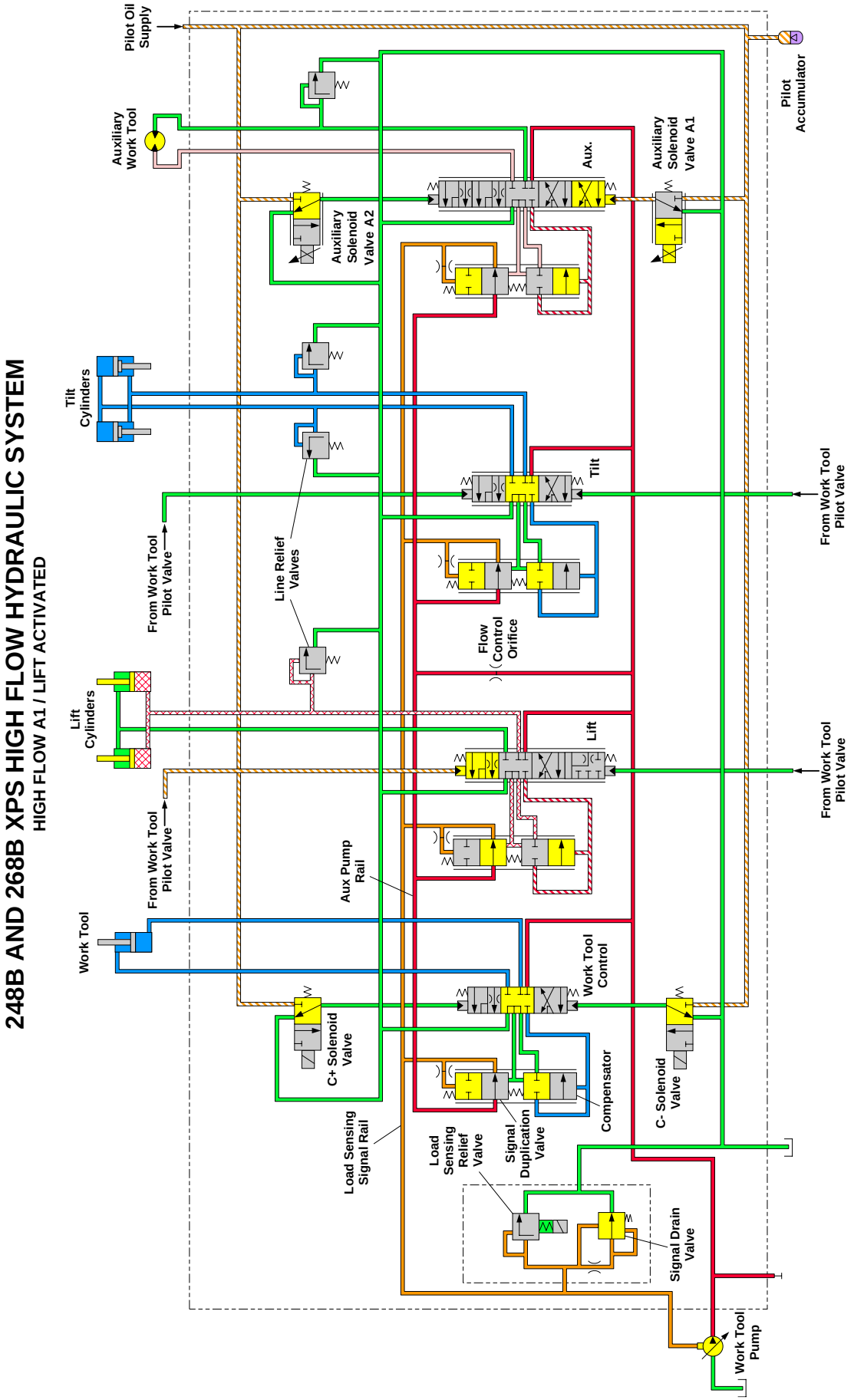

TWO-SPEED HYDROSTATIC DRIVE SYSTEM
FORWARD / TURTLE MODE
From Work Tool Valve Group
Oil Cooler
Fan Motor
Tank
Oil Filter
Return Manifold with Drain
Charge Pump
To Work Tool Valve Group
Work Tool Pump
From Pilot System
Front Trigger
Work Tool Joystick
Speed and Direction Joystick
Interlock ECM
Auxiliary Hydraulic ECM
Charge Piston
Flushing Valve
Two-Speed Selector Spool
Motor Pistons
Hydrostatic Drive Pump Group
Actuator Piston
FWD
REV
RR
RF
LF
LR
MA1
MA2
MB1
MB2
Park Brakes
Drive System Motors
Speed Sensing Valve
Charge Relief Valve
Crossover Relief Valve
Crossover Relief Valve
Two-Speed Solenoid Valve
Park Brake Solenoid Valve
Spool
Travel Pilot Valve Solenoid
Resolver Network
Back-up Alarm
To Pilot System And Accumulator
Travel Pilot Valves
Right
Left
Fwd
Rev
M

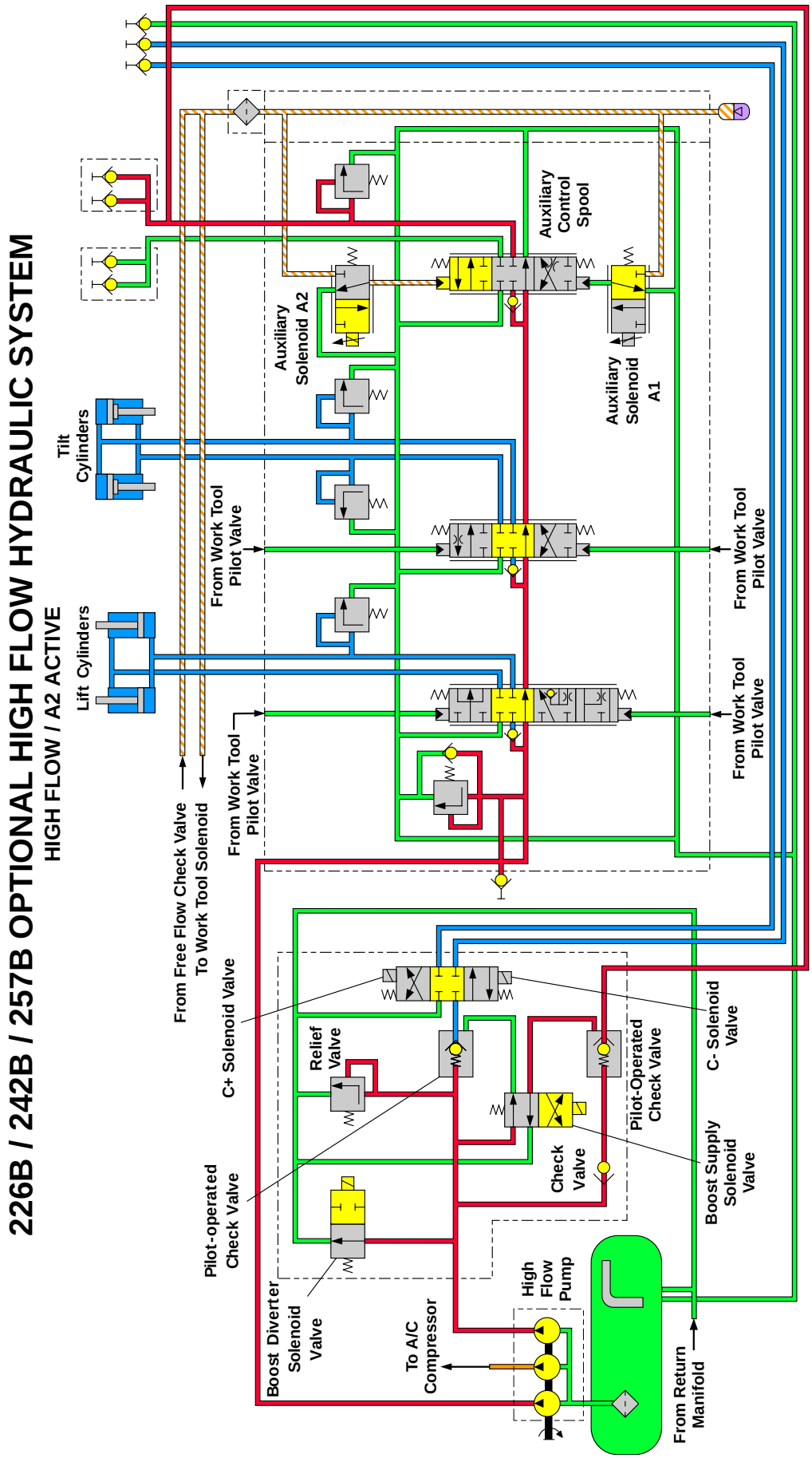

TWO-SPEED HYDROSTATIC DRIVE SYSTEM
FORWARD / RABBIT MODE
From Work Tool Valve Group
Oil Cooler
Fan Motor
Tank
Oil Filter
Return Manifold with Drain
Charge Pump
To Work Tool Valve Group
Work Tool Pump
From Pilot System
Front Trigger
Work Tool Joystick
Speed and Direction Joystick
Interlock ECM
Auxiliary Hydraulic ECM
Charge Piston
Flushing Valve
Two-Speed Selector Spool
Motor Pistons
Hydrostatic Drive Pump Group
Actuator Piston
FWD
REV
RR
RF
LF
LR
MA1
MA2
MB1
MB2
Park Brakes
Drive System Motors
Speed Sensing Valve
Charge Relief Valve
Crossover Relief Valve
Two-Speed Solenoid Valve
Park Brake Solenoid Valve
Spool
Travel Pilot Valve Solenoid
Right
Left
Fwd
Rev
Travel Pilot Valves
Resolver Network
Back-up Alarm
To Pilot System And Accumulator
M

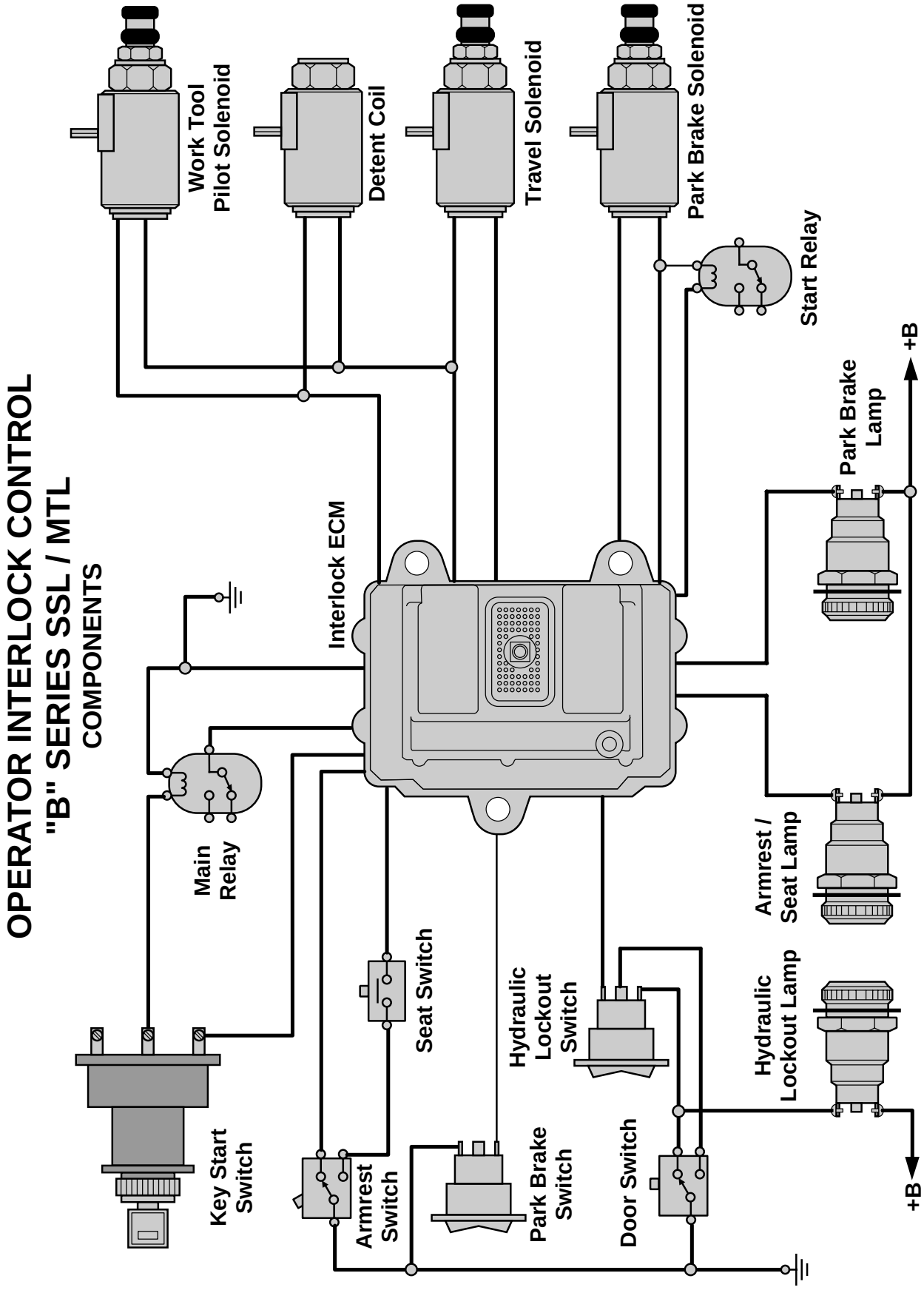

WORK TOOL HYDRAULIC SYSTEM
RAISE
To Work Tool
Auxiliary Control Valve And Solenoids
Tilt Cylinders
Tilt Control Valve
Lift Cylinders
Lift Control Valve
Main Relief Valve
Return Manifold With Drain
Oil Cooler
Fan Motor
A/C Motor
Oil Filter
Manual Lowering Valve
Tank
Charge Pump
Work Tool Pump
Hydrostatic Drive Pump Group
Free Flow Check Valve
To Return Manifold
Work Tool Pilot Valves
Raise
Lower
Rack
Dump
Work Tool Pilot Solenoid


WORK TOOL HYDRAULIC SYSTEM
FLOAT
To Work Tool
Tilt Cylinders
Lift Cylinders
Auxiliary Control Valve And Solenoids
Tilt Control Valve
Lift Control Valve
Main Relief Valve
Return Manifold With Drain
Oil Cooler
Fan Motor
A/C Motor
Oil Filter
Manual Lowering Valve
Tank
Charge Pump
Work Tool Pump
Free Flow Check Valve
Hydrostatic Drive Pump Group
To Return Manifold
Work Tool Pilot Valves
Raise
Lower
Rack
Dump
Work Tool Pilot Valve Solenoid


WORK TOOL HYDRAULIC SYSTEM
RAISE / POSITIONER SOLENOID DE-ENERGIZED
To Work Tool
Auxiliary Control Valve And Solenoids
Tilt Cylinders
Tilt Control Valve
Lift Cylinders
Lift Control Valve
Main Relief Valve
Oil Cooler
Fan Motor
A/C Motor
Oil Filter
Return Manifold With Drain
Work Tool Positioner
Flow Divider
Manual Lowering Valve
Unloading Spool
Positioner Solenoid
Work Tool Pilot Valves
Raise
Lower
Rack
Dump
Work Tool Pilot Valve Solenoid
To Return Manifold
Tank
Charge Pump
Work Tool Pump
Free Flow Check Valve
Hydrostatic Drive Pump Group

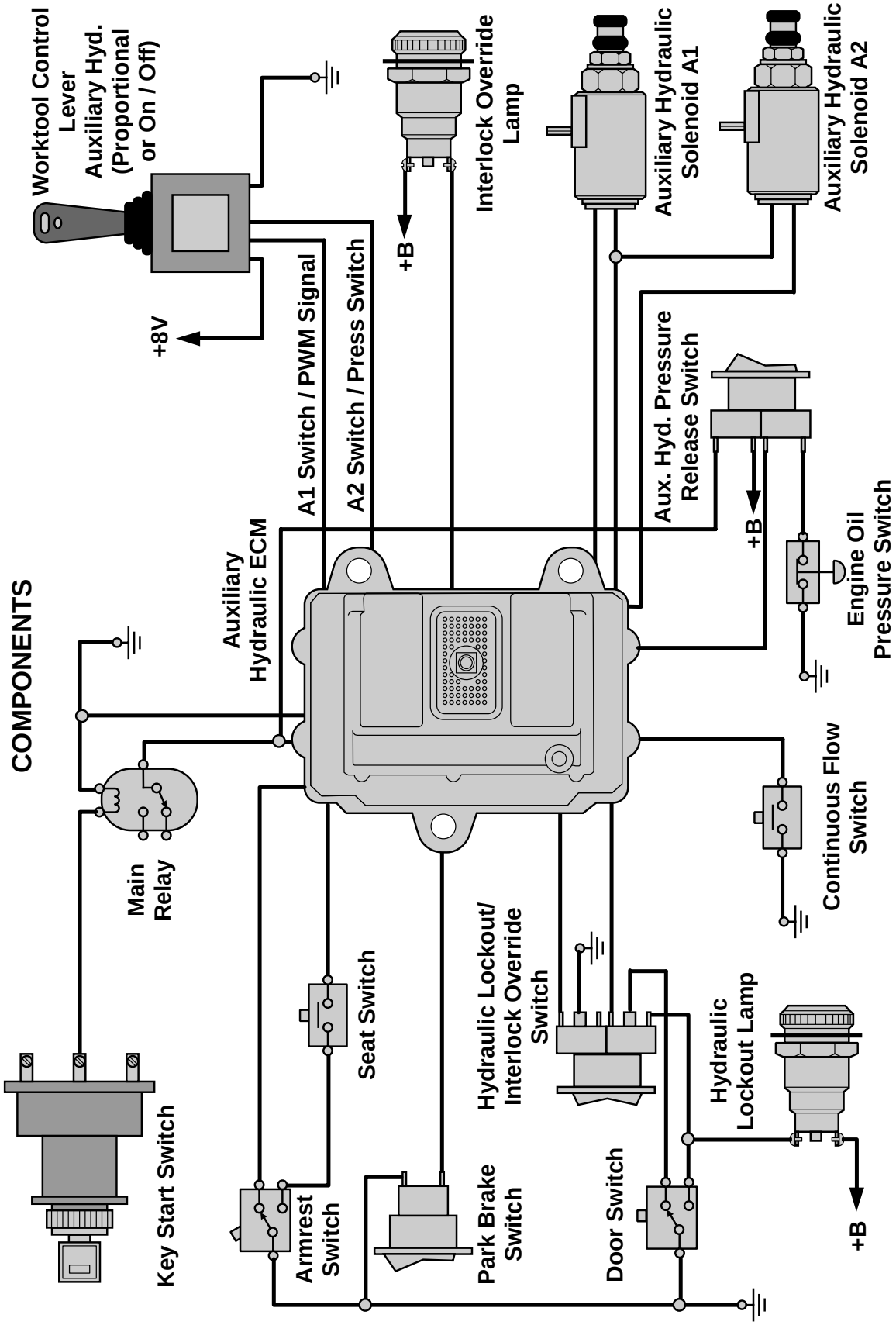

248B AND 268B XPS HIGH FLOW HYDRAULIC SYSTEM
HIGH FLOW A1 / LIFT ACTIVATED
Pilot Oil Supply
Pilot Accumulator
Auxiliary Work Tool
Auxiliary Solenoid Valve A1
Aux.
Auxiliary Solenoid Valve A2
Tilt Cylinders
Tilt
From Work Tool Pilot Valve
From Work Tool Pilot Valve
Line Relief Valves
Flow Control Orifice
Lift Cylinders
Lift
From Work Tool Pilot Valve
From Work Tool Pilot Valve
Aux Pump Rail
Work Tool
Work Tool Control
C+ Solenoid Valve
C- Solenoid Valve
Compensator
Load Sensing Signal Rail
Load Sensing Relief Valve
Signal Duplication Valve
Signal Drain Valve
Work Tool Pump


226B / 242B / 257B OPTIONAL HIGH FLOW HYDRAULIC SYSTEM
HIGH FLOW / A2 ACTIVE
Auxiliary Control Spool
Auxiliary Solenoid A2
Auxiliary Solenoid A1
Tilt Cylinders
Lift Cylinders
From Work Tool Pilot Valve
From Work Tool Pilot Valve
From Work Tool Pilot Valve
From Work Tool Pilot Valve
From Free Flow Check Valve
To Work Tool Solenoid
C+ Solenoid Valve
C- Solenoid Valve
Relief Valve
Pilot-Operated Check Valve
Check Valve
Boost Supply Solenoid Valve
Pilot-operated Check Valve
Boost Diverter Solenoid Valve
To A/C Compressor
High Flow Pump
From Return Manifold

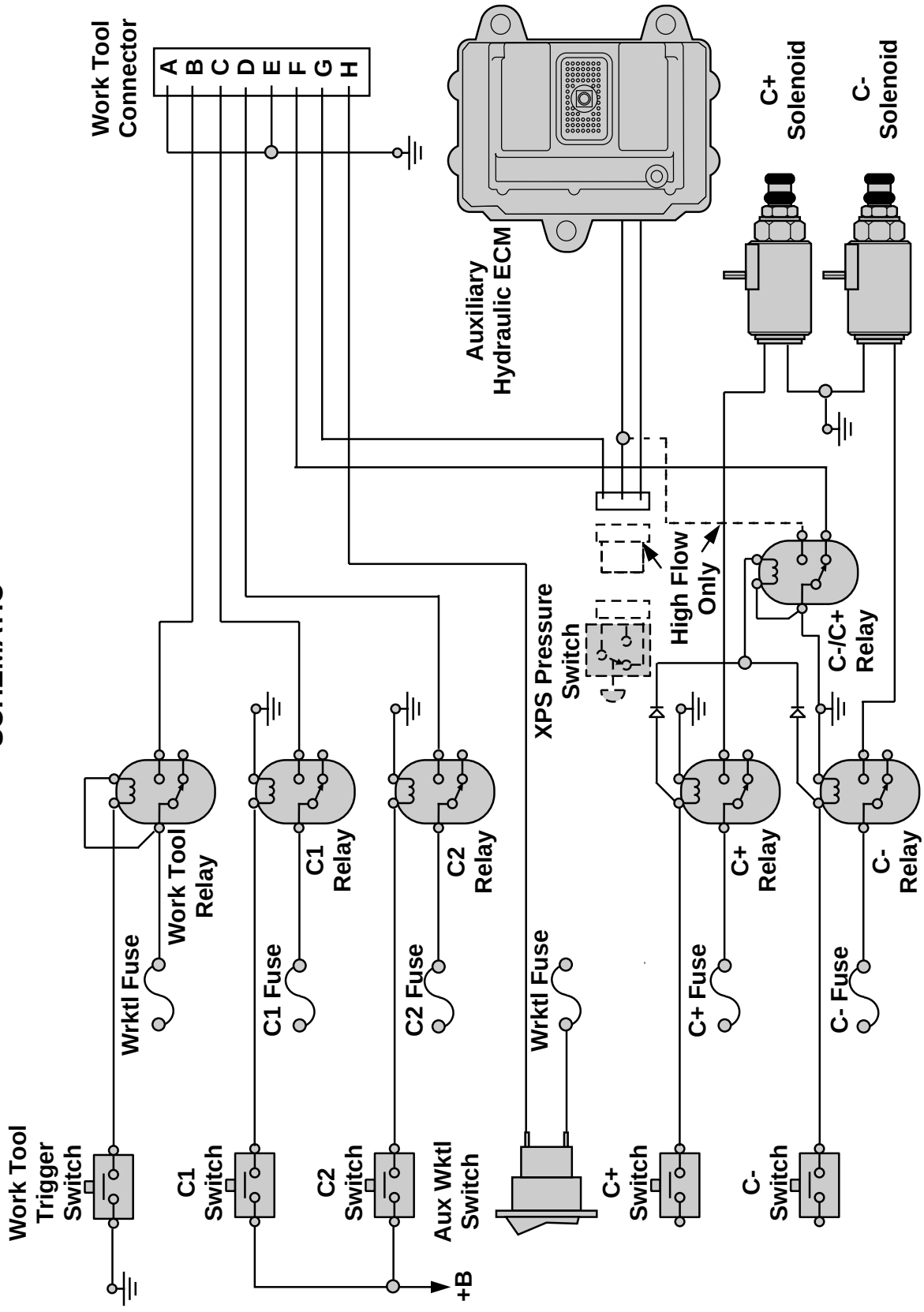

OPERATOR INTERLOCK CONTROL
"B" SERIES SSL / MTL
COMPONENTS
Work Tool Pilot Solenoid
Detent Coil
Travel Solenoid
Park Brake Solenoid
Start Relay
Park Brake Lamp
+B
Interlock ECM
Main Relay
Armrest / Seat Lamp
Seat Switch
Hydraulic Lockout Switch
Hydraulic Lockout Lamp
Key Start Switch
Armrest Switch
Park Brake Switch
Door Switch
+B

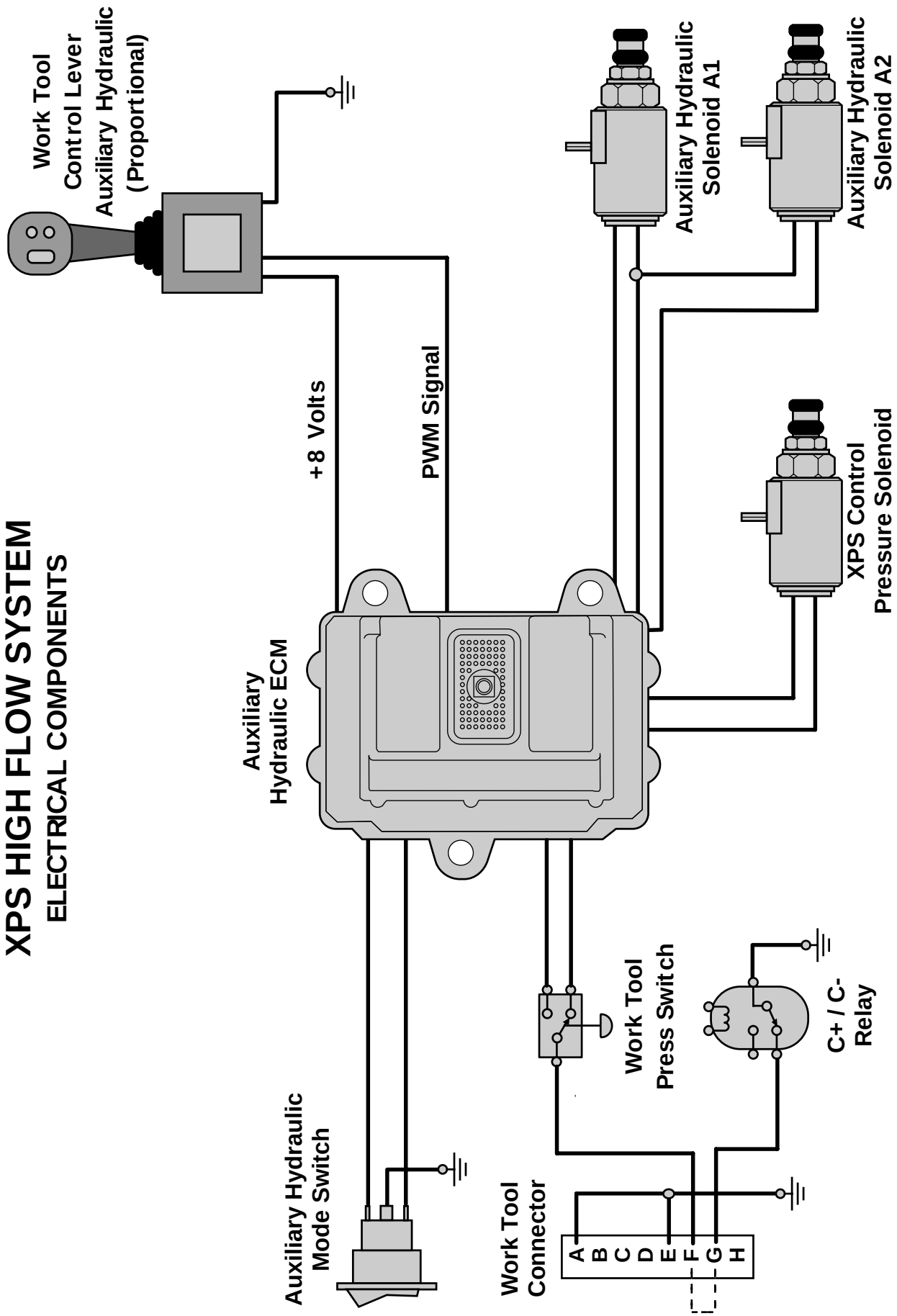
AUXILIARY HYDRAULIC CONTROL "B" SERIES SSL / MTL

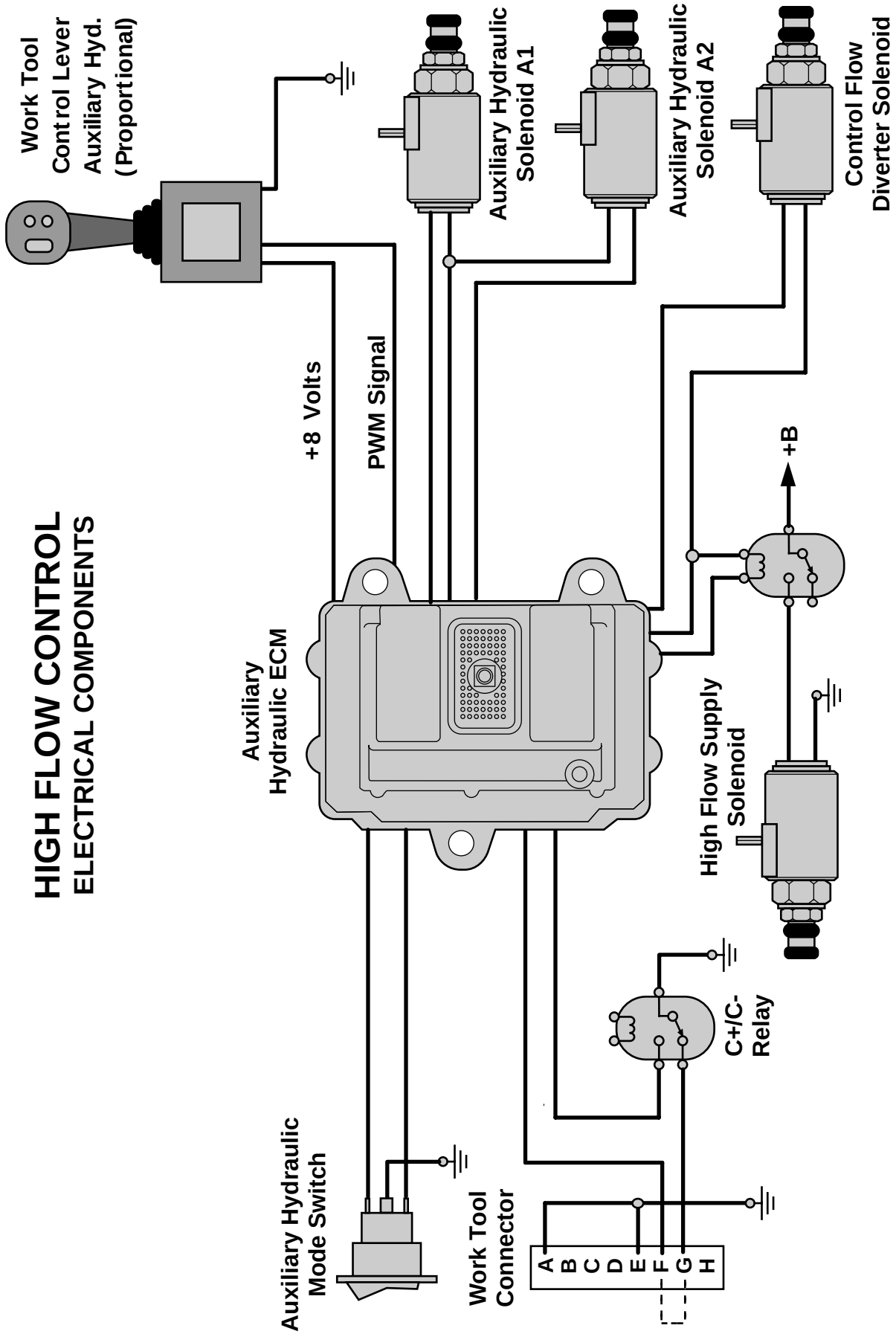
COMPONENTS



WORK TOOL CONNECTOR
SCHEMATIC




XPS HIGH FLOW SYSTEM
ELECTRICAL COMPONENTS
Work Tool
Control Lever
Auxiliary Hydraulic
(Proportional)
+8 Volts
PWM Signal
Auxiliary Hydraulic Solenoid A1
Auxiliary Hydraulic Solenoid A2
XPS Control Pressure Solenoid
Auxiliary Hydraulic ECM
Work Tool Press Switch
C+ / C- Relay
Auxiliary Hydraulic Mode Switch
Work Tool Connector
A
B
C
D
E
F
G
H


HIGH FLOW CONTROL
ELECTRICAL COMPONENTS
Work Tool Control Lever Auxiliary Hyd. (Proportional)
Auxiliary Hydraulic Solenoid A1
Auxiliary Hydraulic Solenoid A2
Control Flow Diverter Solenoid
+8 Volts
PWM Signal
+B
Auxiliary Hydraulic ECM
High Flow Supply Solenoid
C+/C- Relay
Auxiliary Hydraulic Mode Switch
Work Tool Connector
A
B
C
D
E
F
G
H

Machine Walk-around Checklist

Directions: Use this sheet when performing a machine orientation lab exercise.

Place a check in the blank if the fluid level is acceptable.

____ Engine oil level
____ Hydraulic system oil level
____ Cooling system fluid level
____ Fuel level

Place a check in the blank if acceptable or after task was performed.

____ Drain water separator
____ Check seat belt
____ Check air filter indicator

Place a check in the blank after locating each of the following controls.

____ Key start switch
____ Armbar
____ Governor lever
____ Accelerator
____ Worktool lever
____ Speed and direction lever
____ Park brake switch
____ HVAC controls (if equipped)
____ Cab hold-down bolts

Place a check in the blank after locating and reading the following warning labels.

____ Do Not Operate
____ Crush hazard
____ Accumulators
____ Pressurized system
____ Loader arm brace
____ ROPS
____ Use of Jumpers
____ Seat belt

SSL Machine Operation Worksheet

Directions: Before starting the machine: FASTEN SEAT BELT

1. Leave the armrest in the UP position. Start the machine.

   Did the machine start? _____ Yes _____ No

2. Move the armrest to the DOWN position. Start the machine.

   Did the machine start? _____ Yes _____ No

3. With the armrest in the UP position, move the speed/directional joystick to FORWARD.

   Did the machine move? _____ Yes _____ No

4. With the armrest in the UP position, disengage the parking brake switch.

   Did the parking brake lamp indicator change modes? _____ Yes _____ No

5. With the armrest in the UP position, move the implement joystick to RAISE position.

   Did the loader arms raise? _____ Yes _____ No

Drive the machine along the test range.

6. When driving forward remove your foot from the accelerator.

   Did the machine continue moving? _____ Yes _____ No

With the machine in NEUTRAL, and the engine at high idle, operate the implements.

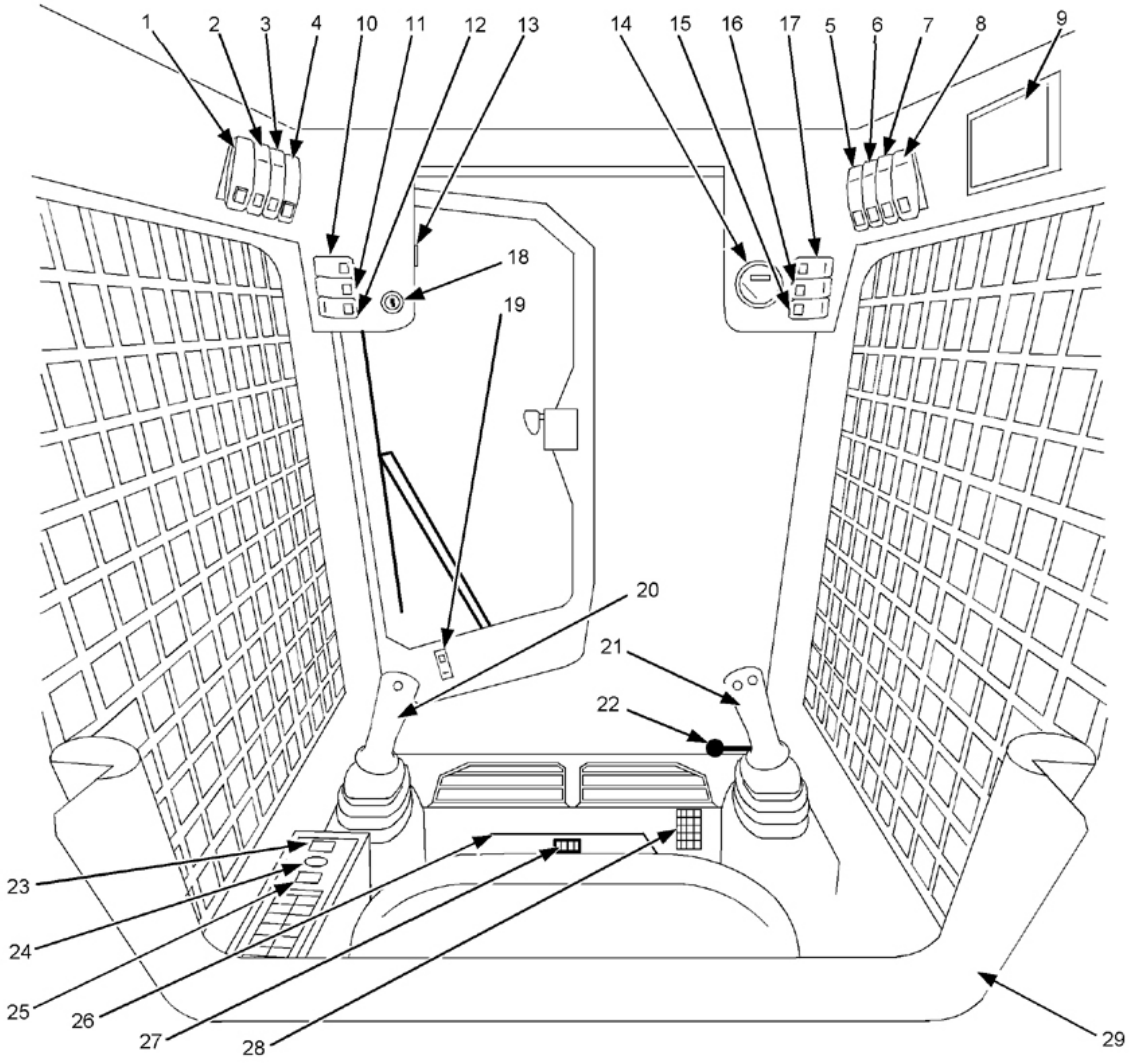
7. Raise the loader arms and then operate the tilt circuit.

   Which implement slows down? Lift Tilt Neither Both

8. Raise the loader arms fully and rack the bucket back. Turn off the machine. Now, operate the implements.

   Can the loader arms be lowered? _____ Yes _____ No

Return the machine to the lab starting point and shutoff the machine and engage the parking brake.



(1) Auxiliary Hydraulic Pressure Release
(2) Automatic Level Control
(3) Auxiliary Electrical Control
(4) WorkTool Coupler Control
(5) Roading Lights
(6) Hazard Flashers
(7) Hydraulic Lockout and Interlock Override
(8) Beacon Switch
(9) Cab Light
(10) Glow Plug Starting Aid
(11) Parking Brake
(12) Auxiliary Hydraulic Model
(13) Service Hour Meter
(14) Fuel Level Gauge
(15) Rear Work Lights
(16) Front Work Lights
(17) Turn Signals
(18) Engine Start Switch
(19) Window Wiper and Window Washer
(20) Joystick Control
(21) Joystick Control
(22) Governor Control
(23) Fan Speed Control
(24) Temperature Control
(25) Air Conditioning Control
(26) Seat Adjustment
(27) Suspension Seat
(28) Accelerator Control
(29) Arm Rest

QUIZ: MACHINE ORIENTATION

***NOTE**: Use the information in the STMG to answer the following questions.*

Modified True/False. If the question is false, circle the word or words that make the statement incorrect and replace with the word(s) to make the statement correct.

____ 1. The Operator Interlock ECM prevents engine starting, machine travel, and work tool operation until certain conditions are met.

____ 2. The machines are equipped with one ECM as standard equipment.

____ 3. The proportional auxiliary hydraulics is standard on all machines equipped with the high flow system.

____ 4. The high performance high flow system (XPS) utilizes an open-center control valve group.

____ 5. The Operator Interlock ECM controls the optional two-speed travel system.

____ 6. A load sensing, pressure compensated, variable displacement piston pump is used to supply oil to the work tool system on all machines.

____ 7. The optional high flow system uses an additional gear pump to supply oil to the auxiliary hydraulic system when active.

____ 8. A turbo charge engine is used on all fifteen models.

____ 9. The hydraulic oil sampling valve is located on the fan motor.

____ 10. The high performance high flow system (XPS) is used on the 228B, 248B and 268B Skid Steer Loaders.

SKID STEER LOADER AND MULTI-TERRAIN LOADER MACHINE SYSTEMS QUIZ

Directions: Circle the letter(s) of the correct answer(s) for each question.

1. Machines ending with the number 6 indicate what type of model?
   a. Base model
   b. Multi-Terrain loaders
   c. XPS high-flow models
   d. Vertical lift models

2. Machines ending with the number 7 indicate what type of model?
   a. Base model
   b. Multi-Terrain loaders
   c. XPS high-flow models
   d. Vertical lift models

3. How many high-flow models are offered?
   a. 6
   b. 5
   c. 4
   d. 3

4. An open door disables which components?
   a. Detent coil
   b. Park brake solenoid
   c. Work tool pilot solenoid
   d. Travel pilot solenoid

5. A raised armbar disables which components?
   a. Detent coil
   b. Park brake solenoid
   c. Work tool pilot solenoid
   d. Travel pilot solenoid

6. Charge pump oil flows through system components in which order?
   a. Work tool coupler valve, fan motor, oil filter, and park brake valve
   b. A/C hydraulic motor, fan motor, oil filter, and speed sensing valve
   c. Oil filter, fan motor, oil cooler, and A/C hydraulic motor
   d. Work tool coupler valve, A/C hydraulic motor, oil filter, and fan motor

SKID STEER LOADER AND MULTI-TERRAIN LOADER
MACHINE SYSTEMS

QUIZ (continued)

7. Which component is part of the anti-stall feature?
   a. Speed sensing valve
   b. Cross-over relief and makeup valves
   c. Travel pilot valves
   d. Charge relief valve

8. MB1 refers to which of the following?
   a. Forward travel drive loop for left motors
   b. Reverse travel drive loop for right motors
   c. Forward travel drive loop for right motors
   d. Reverse travel drive loop for left motors

9. On the XPS high-flow control valve, what is the correct order of hydraulic circuits starting from the frame rail?
   a. Work tool control, tilt, lift, and auxiliary
   b. Lift, tilt, auxiliary, and work tool control
   c. Auxiliary, work tool control, tilt, and lift
   d. Auxiliary, tilt, lift, and work tool control

10. Which components all belong to the auxiliary hydraulic control system?
    a. Continuous flow switch, seat switch, detent coil, and two-speed solenoid
    b. High-flow switch, diagnostic connector, pressure release switch, and park brake switch
    c. Seat switch, high-flow switch, high-flow diverter solenoid, and travel pilot solenoid
    d. Armbar switch, park brake solenoid, high-flow switch, and door switch

11. List the four actions needed to enable the interlock control system and auxiliary hydraulic control system.

    _____
    _____
    _____
    _____

ELECTRONIC SYSTEM - QUIZ

Directions: Place a check in the blank to match the component with its corresponding system.

Component	Auxiliary Hydraulic System	Interlock System	Notes
Armrest Indicator			
Armrest Switch			
Aux Hydraulic Solenoid (A1, A2)			
Aux Hydraulic ECM			
Auxiliary Hydraulic Mode Switch			
Auxiliary Pressure Release Switch			
Auxiliary Hydraulic Switches (A1, A2)			
Continuous Flow Switch			
Detent Coil			
Diagnostic Connector			
Door Switch			
High Flow Diverter Solenoid			
XPS High Flow Pressure Switch			
High Flow Supply Solenoid			
Hydraulic Lockout Indicator			
Hydraulic Lockout Switch			
Interlock ECM			
Interlock Override Indicator			
Interlock Override Switch			
Park Brake Indicator			
Park Brake Solenoid			
Park Brake Switch			
Seat Switch			
Start Relay			
Travel Pilot Solenoid			
Two-speed Solenoid			
Two-speed Switch			
Work Tool Pilot Solenoid			
XPS High Pressure Solenoid			

SKID STEER LOADER HYDROSTATIC DRIVE SYSTEM COMPONENTS AND FUNCTIONS QUIZ

Directions: Match each component to the correct function.

Function	Component
_____	Speed sensing valve
_____	Actuator pistons
_____	Resolver network
_____	Crossover relief valve
_____	Travel pilot valves
_____	Flushing valve
_____	Charge relief valve
_____	PS1 pressure tap
_____	MB pressure tap

Function Definition

A. Provides lubrication and cooling to the internal components of the hydrostatic drive motor

B. When shifted, function as variable pressure reducing valves which direct pilot oil to the actuator pistons

C. A quick disconnect tap where forward drive loop pressure can be checked

D. Is a double check valve which compares two pressure signals and sends the highest resolved pressure to the actuator pistons

E. Control the angle of the hydrostatic pump swashplates

F. Limits the maximum charge pressure in the system

G. Functions as a makeup valve and a relief valve

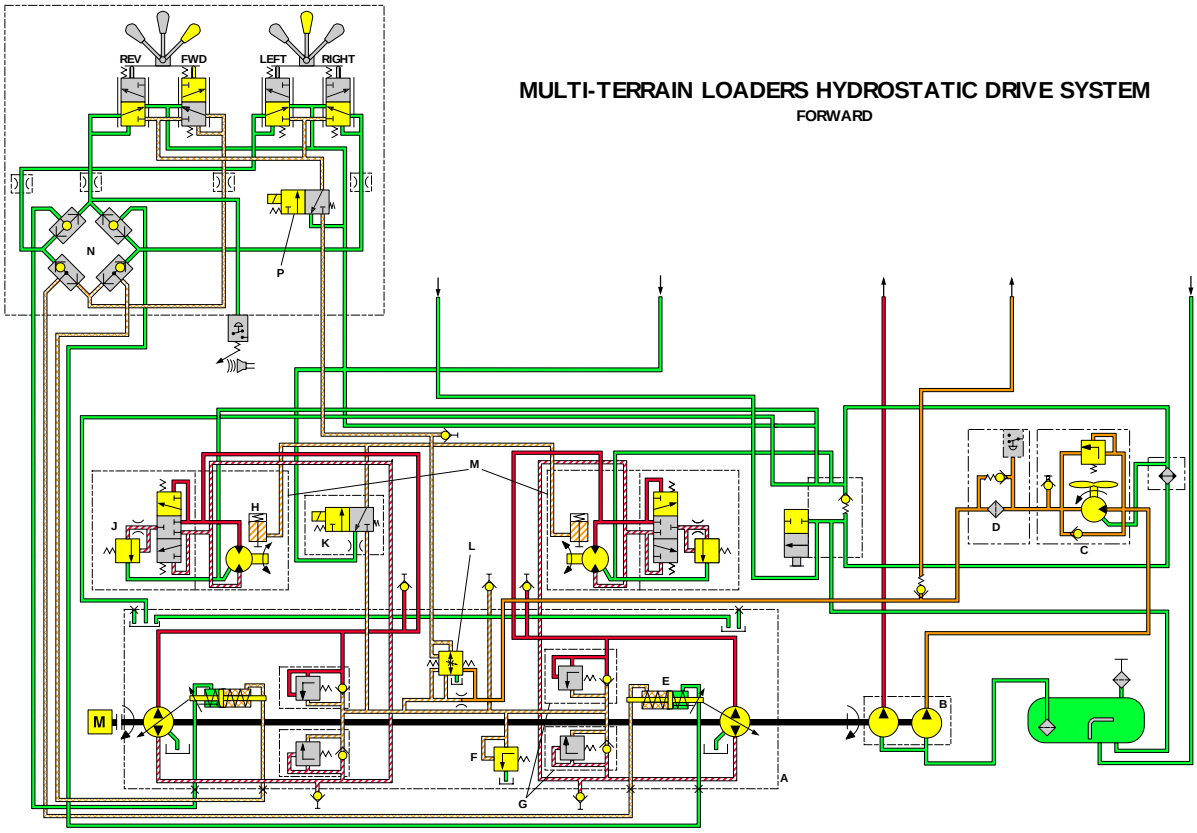
H. Converts charge oil pressure to hydrostatic drive pump signal oil

I. A quick disconnect tap where charge oil pressure can be measured

SSL/MTL HYDROSTATIC DRIVE SYSTEM

COMPONENT LOCATION

QUIZ



Directions: Fill in the blanks next to the terms with the correct letters.

Identify Components:

_____ Resolver Network

_____ Flushing Valve

_____ Travel Pilot Valve Solenoid

_____ Fan Motor

_____ Actuator Piston

_____ Charge Relief Valve

_____ Speed Sensing Valve

_____ Park Brake

_____ Drive System Motor

_____ Oil Filter

_____ Charge Pump

_____ Hydrostatic Drive Pump Group

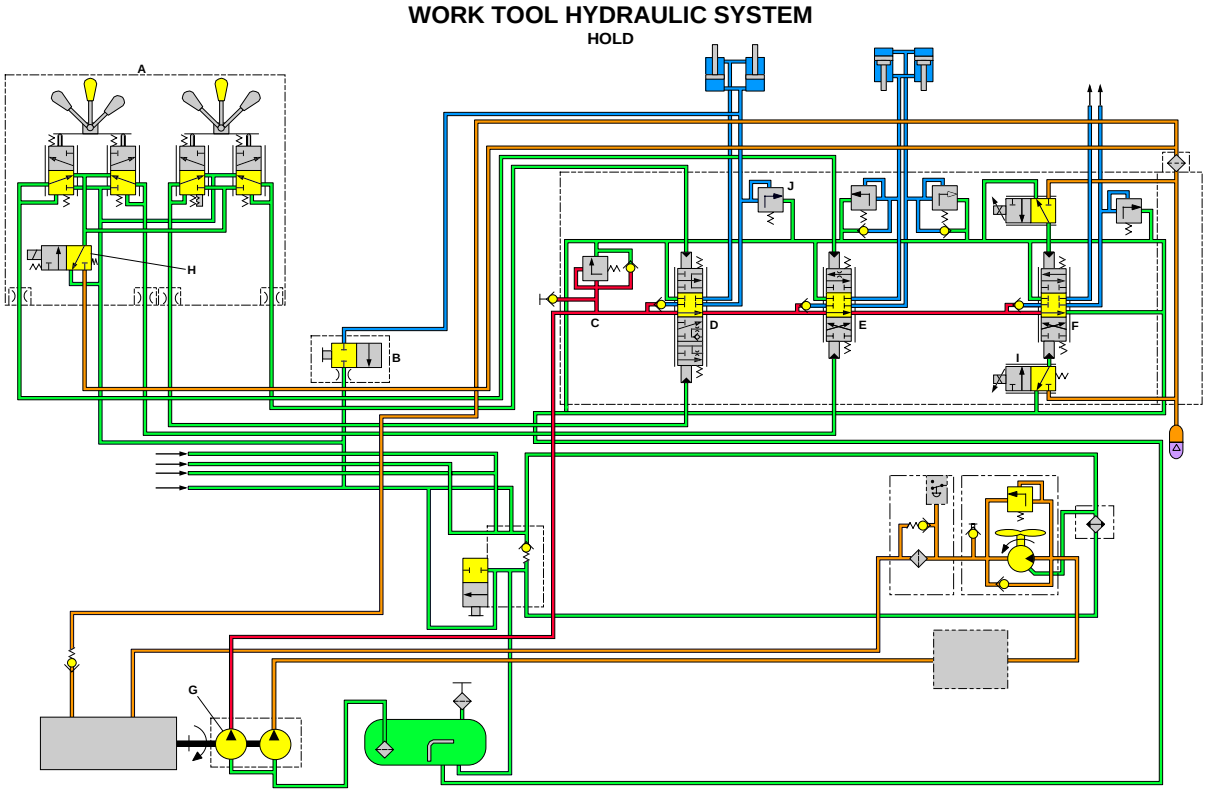
_____ Crossover Relief Valve

_____ Parking Brake Solenoid

SKID **STEER LOADER WORK TOOL SYSTEM**

COMPONENT LOCATION

QUIZ



Directions: Fill in the blanks next to the terms with the correct letters.

Identify Components:

_____ A1 Solenoid Valve

_____ Main Relief Valve

_____ Tilt Control Valve

_____ Work Tool Pilot Solenoid

_____ Manual Lowering Valve

_____ Line Relief Valves

_____ Work Tool Pilot Valves

_____ Work Tool Pump

_____ Lift Control Valve

_____ Auxiliary Control Valve

QUIZ: MACHINE ORIENTATION

ANSWER SHEET

***NOTE**: Use the information in the STMG to answer the following questions.*

Modified True/False. If the question is false, circle the word or words that make the statement incorrect and replace with the word(s) to make the statement correct.

T 1.

F 2. ~~one~~ **(two)**

T 3.

F 4. ~~open-center~~ **(closed-center)**

F 5. ~~Operator Interlock ECM~~ **(Auxiliary Hydraulic ECM)**

F 6. ~~on all machines~~. **(on XPS High Flow machines only)**

T 7.

F 8. ~~all fifteen~~ **(thirteen)**

T 9.

F 10. ~~228B~~ **(228 was discontinued from the product line)**

SKID STEER LOADER AND MULTI-TERRAIN LOADER MACHINE SYSTEMS QUIZ ANSWERS

Directions: Circle the letter(s) of the correct answer(s) for each question.

1. Machines ending with the number 6 indicate what type of model?
   a. Base model
   b. Multi-Terrain loaders
   c. XPS high-flow models
   d. Vertical lift models

2. Machines ending with the number 7 indicate what type of model?
   a. Base model
   b. Multi-Terrain loaders
   c. XPS high-flow models
   d. Vertical lift models

3. How many high-flow models are offered?
   a. 6
   b. 5
   c. 4
   d. 3

4. An open door disables which components?
   a. Detent coil
   b. Park brake solenoid
   c. Work tool pilot solenoid
   d. Travel pilot solenoid

5. A raised armbar disables which components?
   a. Detent coil
   b. Park brake solenoid
   c. Work tool pilot solenoid
   d. Travel pilot solenoid

6. Charge pump oil flows through system components in which order?
   a. Work tool coupler valve, fan motor, oil filter, and park brake valve
   b. A/C hydraulic motor, fan motor, oil filter, and speed sensing valve
   c. Oil filter, fan motor, oil cooler, and A/C hydraulic motor
   d. Work tool coupler valve, A/C hydraulic motor, oil filter, and fan motor

SKID STEER LOADER AND MULTI-TERRAIN LOADER MACHINE SYSTEMS

QUIZ ANSWERS (continued)

7. Which component is part of the anti-stall feature?
   a. Speed sensing valve
   b. Cross-over relief and makeup valves
   c. Travel pilot valves
   d. Charge relief valve

8. MB1 refers to which of the following?
   a. Forward travel drive loop for left motors
   b. Reverse travel drive loop for right motors
   c. Forward travel drive loop for right motors
   d. Reverse travel drive loop for left motors

9. On the XPS high-flow control valve, what is the correct order of hydraulic circuits starting from the frame rail?
   a. Work tool control, tilt, lift, and auxiliary
   b. Lift, tilt, auxiliary, and work tool control
   c. Auxiliary, work tool control, tilt, and lift
   d. Auxiliary, tilt, lift, and work tool control

10. Which components all belong to the auxiliary hydraulic control system?
   a. Continuous flow switch, seat switch, detent coil, and two-speed solenoid
   b. High-flow switch, diagnostic connector, pressure release switch, and park brake switch
   c. Seat switch, high-flow switch, high-flow diverter solenoid, and travel pilot solenoid
   d. Armbar switch, park brake solenoid, high-flow switch, and door switch

11. List the four actions needed to enable the interlock control system and auxiliary hydraulic control system.

Key on _____

Seat Switch _____

Armbar Switch _____

Park Brake Switch _____

ELECTRONIC SYSTEM - QUIZ ANSWERS

Directions: Place a check in the blank to match the component with its corresponding system.

Component	Auxiliary Hydraulic System	Interlock System	Notes
Armrest Indicator		X	
Armrest Switch	X	X	
Aux Hydraulic Solenoid (A1, A2)	X		
Aux Hydraulic ECM	X		
Auxiliary Hydraulic Mode Switch	X		
Auxiliary Pressure Release Switch	X		
Auxiliary Hydraulic Switches (A1, A2)	X		
Continuous Flow Switch	X		
Detent Coil		X	
Diagnostic Connector	X		
Door Switch	X	X	
High Flow Diverter Solenoid	X		
XPS High Flow Pressure Switch	X		
High Flow Supply Solenoid	X		
Hydraulic Lockout Indicator	X	X	
Hydraulic Lockout Switch	X	X	
Interlock ECM		X	
Interlock Override Indicator	X		
Interlock Override Switch	X		
Park Brake Indicator		X	
Park Brake Solenoid		X	
Park Brake Switch	X	X	
Seat Switch	X	X	
Start Relay		X	
Travel Pilot Solenoid		X	
Two-speed Solenoid	X		
Two Speed Switch	X		
Work Tool Pilot Solenoid		X	
XPS High Pressure Solenoid	X		

SKID STEER LOADER HYDROSTATIC DRIVE SYSTEM COMPONENTS AND FUNCTIONS QUIZ ANSWERS

Directions: Match each component to the correct function.

Function	Component
H	Speed sensing valve
E	Actuator pistons
D	Resolver network
G	Crossover relief valve
B	Travel pilot valves
A	Flushing valve
F	Charge relief valve
I	PS1 pressure tap
C	MB pressure tap

Function Definition

A. Provides lubrication and cooling to the internal components of the hydrostatic drive motor

B. When shifted, function as variable pressure reducing valves which direct pilot oil to the actuator pistons

C. A quick disconnect tap where forward drive loop pressure can be checked

D. Is a double check valve which compares two pressure signals and sends the highest resolved pressure to the actuator pistons

E. Control the angle of the hydrostatic pump swashplates

F. Limits the maximum charge pressure in the system

G. Functions as a makeup valve and a relief valve

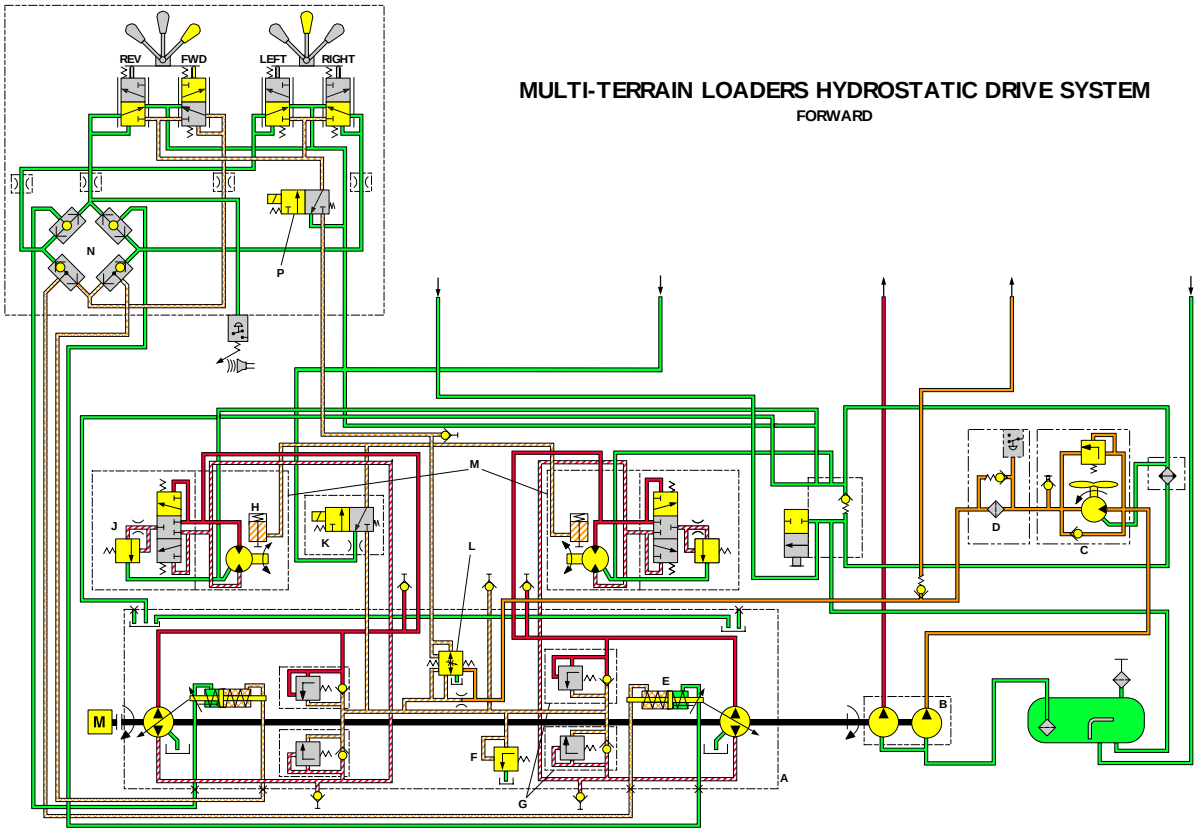
H. Converts charge oil pressure to hydrostatic drive pump signal oil

I. A quick disconnect tap where charge oil pressure can be measured

SSL/MTL HYDROSTATIC DRIVE SYSTEM

COMPONENT LOCATION

QUIZ ANSWERS



Directions: Fill in the blanks next to the terms with the correct letters.

Identify Components:

N Resolver Network

H Park Brake

J Flushing Valve

M Drive System Motor

P Travel Pilot Valve Solenoid

D Oil Filter

C Fan Motor

B Charge Pump

E Actuator Piston

A Hydrostatic Drive Pump Group

F Charge Relief Valve

G Crossover Relief Valve

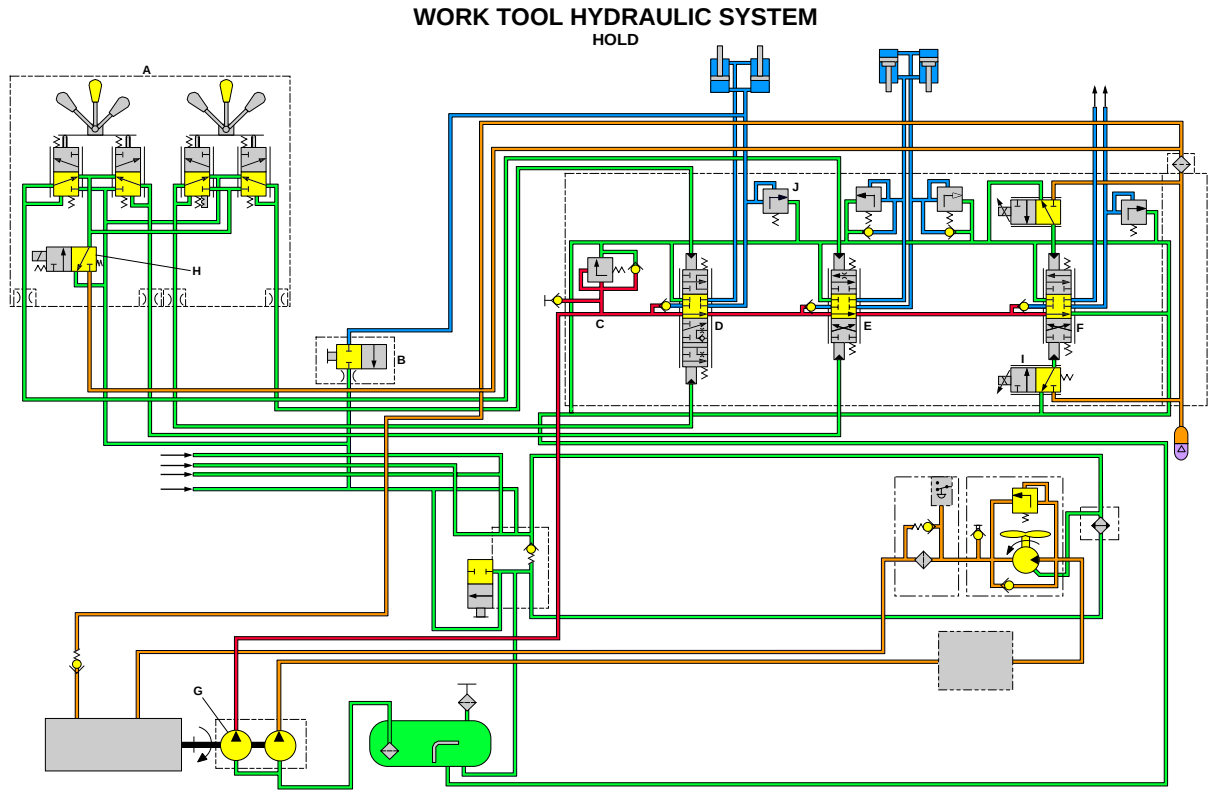
L Speed Sensing Valve

K Parking Brake Solenoid

SSL/MTL WORK TOOL SYSTEM

COMPONENT LOCATION

QUIZ ANSWERS



Directions: Fill in the blanks next to the terms with the correct letters.

Identify Components:

__**I**__ A1 Solenoid Valve

__**C**__ Main Relief Valve

__**E**__ Tilt Control Valve

__**H**__ Work Tool Pilot Solenoid

__**B**__ Manual Lowering Valve

__**J**__ Line Relief Valves

__**A**__ Work Tool Pilot Valves

__**G**__ Work Tool Pump

__**D**__ Lift Control Valve

__**F**__ Auxiliary Control Valve